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Remedial Investigation Report for OU B-2 Sites

Former Naval Air Facility
Adak, Alaska

Department of the Navy
Naval Facilities Engineering Command Northwest
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Document Identification

Revision Number	Final
Document Title	Remedial Investigation Report for OU B-2 Sites
Site Name	Former Naval Air Facility, Adak, Alaska
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Report Coverage	This report presents the remedial investigation and risk assessment findings for 24 areas of concern located in OU B-2. These investigations and risk evaluations were conducted in accordance with the *Final Remedial Investigation Work Plan for OU B-2, Adak Island (TetraTech)*, dated June 6, 2008.
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Report Overview

The content and organizational structure for the *Remedial Investigation Report for OU B-2 Sites* is based on required and suggested elements of remedial investigation/risk assessment (RI/RA) reports identified in the following guidance documents:

- *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988)
- *Department of the Navy Environmental Restoration Program Manual* – Chapter 8.2 Remedial Investigations and Risk Assessments (U.S. Navy 2006)
- *Ecoscoping Guidance* (ADEC 2008a)
- *Risk Assessment Procedures Manual Update* (ADEC 2005)
- *Risk Assessment Procedures Manual* (ADEC 2000)

Table RO-1 presents a crosswalk between this report and the required elements of a RI report and RA.

In addition, the portions of the report that deal with investigating munitions and explosives of concern (MEC) and with assessing hazards associated with MEC also comply with the requirements of NOSSAINST 8020.15A (*Guidance for Preparing an Explosives Safety Submission—MRS Investigation or Characterization*). Table RO-2 presents a crosswalk for this information.

TABLE RO-1
Remedial Investigation and Risk Assessment Crosswalk

Item	RI/RA Requirement	Source	Report Location
1	Executive Summary	EPA 1988; Navy 2006	Executive Summary
2	Introduction	EPA 1988; Navy 2006	Section 1
3	Purpose of Report	EPA 1988; Navy 2006	Section 1.1
4	Site Description	EPA 1988; Navy 2006	Section 1.2 (general) and Section 4 (AOC-specific)
5	Site History	EPA 1988; Navy 2006	Section 1.2
6	Previous Investigations	EPA 1988; Navy 2006	Section 3
7	Report Organization	EPA 1988; Navy 2006	Section 1.3
8	Study Area Investigation	EPA 1988; Navy 2006	Sections 4 and 5
9	Physical Characteristics of Study Area	EPA 1988; Navy 2006	Section 2
10	Surface Features	EPA 1988; Navy 2006	Section 2.2
11	Meteorology	EPA 1988; Navy 2006	Section 2.1
12	Surface Water	EPA 1988; Navy 2006	Section 2.3
13	Geology	EPA 1988; Navy 2006	Section 2.4
14	Soils	EPA 1988; Navy 2006	Section 2.4
15	Hydrogeology	EPA 1988; Navy 2006	Section 2.5
16	Demographics and Land Use	EPA 1988; Navy 2006	Section 2.6
17	Ecology	EPA 1988; Navy 2006	Section 2.7
18	Nature and Extent of Contamination	EPA 1988; Navy 2006	Section 7

TABLE RO-1
Remedial Investigation and Risk Assessment Crosswalk

Item	RI/RA Requirement	Source	Report Location
19	Sources	EPA 1988; Navy 2006	Section 4
20	Soils	EPA 1988; Navy 2006	Section 7
21	Groundwater	EPA 1988; Navy 2006	Section 7
22	Surface Water and Sediments	EPA 1988; Navy 2006	Section 7
23	Air	EPA 1988; Navy 2006	Not addressed, not required for OU B-2 contaminants (MEC and MC)
24	Contaminant Fate and Transport	EPA 1988; Navy 2006	Section 4.1; Section 5.6; Section 9
25	Potential Routes of Migration	EPA 1988; Navy 2006	Section 4.1; Section 5.6; Section 9
26	Contaminant Persistence	EPA 1988; Navy 2006	Section 4.1; Section 9
27	Contaminant Migration	EPA 1988; Navy 2006	Section 4.1; Section 5.6: Section 9
28	Baseline Risk Assessment	EPA 1988; Navy 2006	Section 8 (explosive hazards); Section 9 (chemical hazards)
29	Human Health Risk	EPA 1988; ADEC 2005; ADEC 2000	Section 8 (explosive hazards); Section 9 (chemical hazards)
30	Ecological Risk	EPA 1988; ADEC 2008; ADEC 2005; ADEC 2000	Section 9
31	Summary and Conclusions	EPA 1988; Navy 2006	Section 10

TABLE RO-2
NOSSA Crosswalk

Item	Requirement	Report Location
1	Executive summary	Executive Summary
2	Verification Statement	Report Overview
3	Current determined or reasonably anticipated future land use for each MRS (or AOC) covered by this report	Section 2.6
4	Description of each MRS, including size	Section 4
5	Discussion of site characterization methods and technology, including relative effectiveness and limitations of technologies used during the munitions response, and the effects on residual hazard/risk relative to that which was originally projected	Section 4.2; Sections 5.2 and 5.6.1; Section 8
6	Rationale for any variations from the expected implementation of the approved ESS that affected the outcome	Sections 5.2 and 5.3
7	Information regarding areas within the MRS where munitions response activities were not conducted, together with the rationale for not conducting them	Section 4; Sections 5.1 and 5.6.1; and Section 7
8	Summary of the MEC and MPPEH found and/or recovered including final disposition of each	Sections 5.2 and 5.4; Appendix C
9	Summary of the project QC and QA reports	Section 5.2; Appendix C

TABLE RO-2
NOSSA Crosswalk

Item	Requirement	Report Location
10	A summary of the land use controls that were implemented, if any, and the areas to which they apply	Not applicable – currently Navy restricted property
11	A summary of provisions for long-term management, including maintenance, monitoring, record-keeping, 5-year reviews, etc.	Not applicable – currently under evaluation for remedial action
12	Request to cancel any exclusion zones or other site approvals established in support of the munitions response	Not applicable
13	Maps (scale 1"/400') preferred showing:	
	• Current, determined or reasonable anticipated future land use	Section 2 (land use)
	• Areas within an MRS where response actions were executed and the clearance depth	Section 5.4
	• Areas within an MRS where response actions were not performed	Section 8 (munitions hazard)
	• MC sampling locations and analytical results	Sections 5, 7, 8 and 9
	• Residual munitions hazard and chemical risk	
14	Digitally recorded and geo-referenced maps of subsurface geophysical anomalies, including suspected munitions	Section 5.6.1 (intrusive investigation results), Appendix C (DGM results)
15	Dig sheets for all excavations on projects where geophysical mapping and investigation occurred	Appendix C
16	Color photographs of major activities and recovered MEC	Section 5; Appendix C; Appendix D
17	Videotape with voice narration showing major response activities and recovered MEC.	Not applicable
18	Description and results of laboratory analyses of MC sampling	Sections 5.4, 5.5, and 5.6.2; Appendix E
19	Archaeological sites or environmentally sensitive areas that were encountered and a description of any corrective, mitigation, or protective measures taken	Appendixes H, I, and J

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Acronyms and Abbreviations

AA	anti-aircraft
AAR	after-action report
ADEC	Alaska Department of Environmental Conservation
ADOT	State of Alaska Department of Transportation
AMNWR	Alaska Maritime National Wildlife Refuge
AO	abandoned ordnance
AOC	area of concern
AOPC	area of potential concern
A/PIA	Aleutian/Pribilof Islands Association, Inc.
APP	accident prevention plan
APT	armor-piercing tracer
ARARs	applicable or relevant and appropriate requirements
asl	above sea level
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
BHHRA	Baseline Human Health Risk Assessment
BIP	blow in place
BRAC Act	Base Realignment and Closure Act
°C	degrees Celsius
CAD	cartridge-actuated device
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
cm	centimeter(s)
COCs	chain-of-custody records
COPCs	chemicals of potential concern
CRP	Community Relations Plan
CS	riot control tear gas
CSM	conceptual site model
CWM	chemical warfare materiel
DDESB	Department of Defense Explosives Safety Board
DFWs	definable features of work
DGM	digital geophysical mapping
DGPS	differential global position system
DMM	discarded military munitions
DoD	Department of Defense
DOI	Department of the Interior
DOT	Department of Transportation
DQOs	data quality objectives
EBs	ecological benchmarks
EOD	Explosive Ordnance Disposal
EMT	Emergency Medical Technician
EPA	U.S. Environmental Protection Agency
EPCs	exposure point concentrations
EPP/WMP	Environmental Protection Plan/Waste Management Plan

ERBSCs	ecological risk-based screening concentrations
ESHA	Explosives Safety Hazard Assessment
ESS	Explosives Safety Submission
EZ	exclusion zone
°F	degrees Fahrenheit
FCR	field change request
FFA	Federal Facilities Agreement
frag	fragments
FS	feasibility study
ft	foot/feet
ftp	file transfer protocol
GIS	geographic information system
GPO	geophysical prove-out
GPS	global position system
HE	high explosive
HEDP	high explosive dual purpose
HE-T/SD	high explosive-tracer/self destruct
HI	hazard index
HMX	Octahydro-1, 3, 5, 7-tetranitro-1, 3, 5, 7-tetrazocine
Hz	hertz (cycles per second)
i	groundwater gradient
IAS	initial assessment study
ID	identification
IR	Installation Restoration
IRIS	integrated risk information system
ITS	instrument test strip
K	hydraulic conductivity
lb	pound
LORAN	long-range navigation
m	meter(s)
MC	munitions constituents
mcf	million cubic feet
MC QAPP	Munitions Constituent Quality Assurance Project Plan
MD	munitions debris
MDLs	method detection limits
MEC	munitions and explosives of concern
MedEvac	medical evacuation
MGFD	munition with the greatest fragmentation distance
mg/kg	milligrams per kilogram
MILSTD	Military Standard
MIS	multi-incremental sampling
MLLW	mean lower low water
mm	millimeter
MPPEH	material potentially presenting an explosive hazard

MS/MSD	matrix spike/matrix spike duplicate
mV	millivolt(s)
η	porosity
NACIP	Navy Assessment and Control of Installation Pollutants
NAD83	North American Datum 1983
NAF	Naval Air Facility
NAS	Naval Air Station
NAVFAC NW	Naval Facilities Engineering Command Northwest
NAVSEA	Navy Sea Systems Command
NEDD	Naval Electronic Data Deliverable
NEDDS	Naval Electronic Data Delivery System
NEESA	Naval Energy and Environmental Support Activity
NFESC	Naval Facilities Engineering Services Center
NIRIS	Navy Installation Restoration Information Solution
NOFA	no further action
NOSSA	Naval Ordnance Safety and Security Activity
NPL	National Priorities List
NTCRA	non-time-critical removal action
NTR	Navy Technical Representative
NTU	nephelometric turbidity units
OB/OD	open burn/open detonation
OE	ordnance and explosives
OU	operable unit
PA	preliminary assessment
PCBs	polychlorinated biphenyls
Pd	probability of detection
PDAs	personal digital assistants
PLO	Public Land Order
PM	project manager
PP	proposed plan
PPE	personal protective equipment
PQCM	Program Quality Control Manager
PSEs	preliminary source evaluations
PTFE	polytetrafluoroethylene
QA/QC	quality assurance and quality control
QA	Quality Assurance
QC	Quality Control
QAPP	quality assurance project plan
QCM	Quality Control Manager
QSM	DoD Quality Systems Manual for Environmental Laboratories
RAAs	remedial action areas
RAB	Restoration Advisory Board
RAOs	remedial action objectives
RBSCs	risk-based screening concentrations
RCA	root cause analysis
RDX	cyclotrimethylenetrinitramine
RI	remedial investigation

ROD	Record of Decision
RPM	Remedial Project Manager
RRD	range-related debris
RTK-DGPS	real-time kinematic differential global positioning system
SARA	Superfund Amendments and Reauthorization Act
SAERA	State-Adak Environmental Restoration Agreement
SDG	sample delivery group
SI	site investigation
SM	Site Manager
SOP	Standard Operating Procedure
SOW	Scope of Work
SRA	Screening Level Risk Assessment
SUXOS	Senior UXO Supervisor
SVOCs	semi-volatile organic compounds
SWMUs	Solid Waste Management Units
TAC	The Aleut Corporation
TCRA	time-critical removal action
TDEM	time domain electromagnetic
TFU	thermal flashing unit
TL	team leader
TNT	trinitrotoluene
TPH	total petroleum hydrocarbons
TSD	team separation distance
URS	URS Consultants, Inc.
USACE	U.S. Army Corps of Engineers
USAE	USA Environmental
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UXO	unexploded ordnance
UXOQC	UXO Quality Control
UXOQCS	UXO Quality Control Specialist
UXOSO	UXO Safety Officer
v	groundwater velocity
VOCs	volatile organic compounds
Whites XLT	Whites XLT® Spectrum metal detector
WP	Work Plan
WS	Worksheet
WWII	World War II

SECTION 1

Introduction

1.1 Purpose and Scope

The purpose of the remedial investigation (RI) was to collect and analyze data at sites potentially contaminated with munitions and explosives of concern (MEC) and munitions constituents (MC). This work was performed in order to evaluate potential explosive hazards from MEC and to assess potential risk from MC contamination at 24 operable unit (OU) B-2 sites at the former Naval Air Facility (NAF) on Adak Island, Alaska. Data used to develop the OU B-2 RI were collected in 1999, 2000, and 2008. The areas of concern (AOCs) at OU B-2 are as follows:

- Andrew Lake Disposal Area (ALDA-01)
- Andrew Lake Beach Crater Area (ALDA-02)
- Andrew Lake Seawall (ALSW-01)
- Blind Cove/Camper's Cove Impact Area Firing Point 1 (BC-03)*
- Combat Range 1 Mortar Impact Area (C1-01)
- Andrew Lake Hand Grenade Range (HG-01)
- J.M. Candidate Chemical Weapons Disposal Area (JM-01)*
- Lake Jean Disposal Area (LJ-02A)*
- Andrew Lake World War II Magazine (MAG-01)
- Andrew Lake Rocket Disposal Area (MI-01)
- Andrew Lake 40 mm Impact Area (MI-02)
- Andrew Lake Mortar Impact Area (MI-03)
- Mt. Moffett Impact Area Lone 81 millimeter (mm) Mortar (MM-10D)*
- Andrew Lake Disposal Area (OB/OD-01)
- Andrew Lake 40 mm Rifle Grenade Range (RG-01)**
- Andrew Lake Hand Grenade/40 mm Impact Area (RR-01)
- Andrew Lake Mortar Impact Area (RR-02)
- Andrew Lake Flare Disposal Area (RR-03)*
- Andrew Lake Range Remainder (RR-04)
- Andrew Lake Subcaliber Training Range (SA-01)
- Source Area 93 Multiple Impact Area (SA93-01)
- Source Area 93 Eastern Impact Area (SA93-02)
- Source Area 93 Firing Point (SA93-03)
- Source Area 93 Eastern Disposal Area (SA93-04)

As part of planning for the 2008 RI, data from the 1999 and 2000 investigations were evaluated to determine whether the information was adequate to assess risk and evaluate remedial alternatives in a feasibility study (FS), then proceed to the proposed plan (PP) and Record of Decision (ROD) for OU B-2. Data gaps were identified at 18 of the 24 AOCs. The 2008 RI Work Plan (TetraTech, 2008) documented the gaps and described the field activities necessary to fill them at each of the 18 AOCs.

Existing information was deemed sufficient to conclude that no further action (NOFA) was required at five of the remaining six AOCs (indicated by a single asterisk in the preceding list). These AOCs were assigned NOFA status because they could not be located, did not contain evidence of MEC, or were fully surveyed and cleared of MEC. In addition to these NOFA sites, earlier investigations had concluded that conditions at RG-01 (indicated by two asterisks in the preceding list) were sufficiently hazardous to merit removal of MEC under a non-time-critical removal action (NTCRA), so further investigation of the AOC was not included in the 2008 RI Work Plan. The NTCRA at RG-01 was conducted during the 2006 and 2008 field seasons, and the results of site inspections and characterization activities conducted in support of the NTCRA were reported in an after-action report (AAR) (USA Environmental [USAE] 2009). Although the data collected at RG-01 during the NTCRA were not part of the RI, these data are summarized in this report so as to complete the Explosives Safety Hazard Assessment (ESHA) and chemical risk assessment evaluations that determine whether further action is required at the AOC.

The Final RI Work Plan (TetraTech, 2008) was approved on June 6, 2008. During the course of the 2008 field season, weekly conference calls were held to discuss the progress of the RI and evaluate the need for possible changes to the approved RI Work Plan. Agreed-upon changes were recorded through the field change request (FCR) process and in meeting notes, which are included in Appendix A of this report.

Once remedial activities at OU B-2 AOCs are complete, the Navy and Department of Defense (DoD) intend to transfer the property to the Department of the Interior (DOI). Accordingly, this project is being conducted to meet Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) 120; CERCLA 120(h); and DoD 6055.9-STD site characterization requirements for federal land transfer. All actions required under CERCLA must be completed prior to assertion that the CERCLA 120(h) covenant requirements are met and the real estate can be transferred.

1.2 Site Background

Adak Island is located approximately 1,200 air miles southwest of Anchorage, Alaska, in the Aleutian Island chain (Figure 1-1). At 280 square miles, it is the largest of the Andreanof Group of the Aleutian Islands.

The developed portion of Adak is limited to the northern half of the island, which became a military reservation during World War II (WWII). When the military use of Adak declined and the Navy began the investigation and cleanup of MEC on the military reservation, an OU was created to organize this work. Initially, MEC work was contained in a single unit designated OU B. This OU was later divided into two segments, OU B-1 and OU B-2, to facilitate remediation and transfer of former military property for civilian use. Four land transfer parcels were also developed to manage the transfer activities. Most of the developed area on Adak is included in Land Transfer Parcels 1 through 3. These parcels were relinquished from DoD to DOI, which transferred property to The Aleut Corporation (TAC), the City of Adak, the U.S. Fish and Wildlife Service (USFWS), and the State of Alaska Department of Transportation (ADOT) for unrestricted use in 2004.

The remaining DoD property not included in the land transfer—approximately 5,624 acres—is considered the current military reservation and consists of Land Transfer Parcel 4 (Figure 1-2). Parcel 4 encompasses most of the land surrounding Andrew Lake at the north end of Adak Island. It contains all of the OU B-2 sites that are the subject of this RI and several OU B-1 sites that also were not relinquished. The OU B-1 sites are addressed under their own ROD and are not included in this RI.

1.2.1 Site History

The following sections contain a brief description of the historical military and cultural uses of Adak Island.

1.2.1.1 Military Use

The United States declared war on Japan after the Japanese attacked Pearl Harbor on December 7, 1941. On June 3, 1942, the Japanese attacked Dutch Harbor in the Aleutian Islands. In an attempt to split the U.S. forces, the attack was apparently timed to occur in sequence with an advance toward Midway Island. The attack on Dutch Harbor was turned back by land-based air units operating from bases at Umnak and Cold Bay that had been completed 6 months prior to the attack. The Japanese naval force retreated to the west and occupied Kiska Island (previously the site of a naval weather station) on June 7, 1942. On June 11, 1942, aerial reconnaissance confirmed that the enemy had become firmly entrenched on the islands of Kiska and Attu (Cohen, 1981). Adak Island, because of its strategic location, was selected by the military as a base of operations to counteract the Japanese invasion. A U.S. military landing force entered Kuluk Bay on August 30, 1942. The primary mission of the landing force was to construct a runway to accommodate fighter, light bomber, and light transport aircraft and to support the continuing offensive against the Japanese farther down the Aleutian chain.

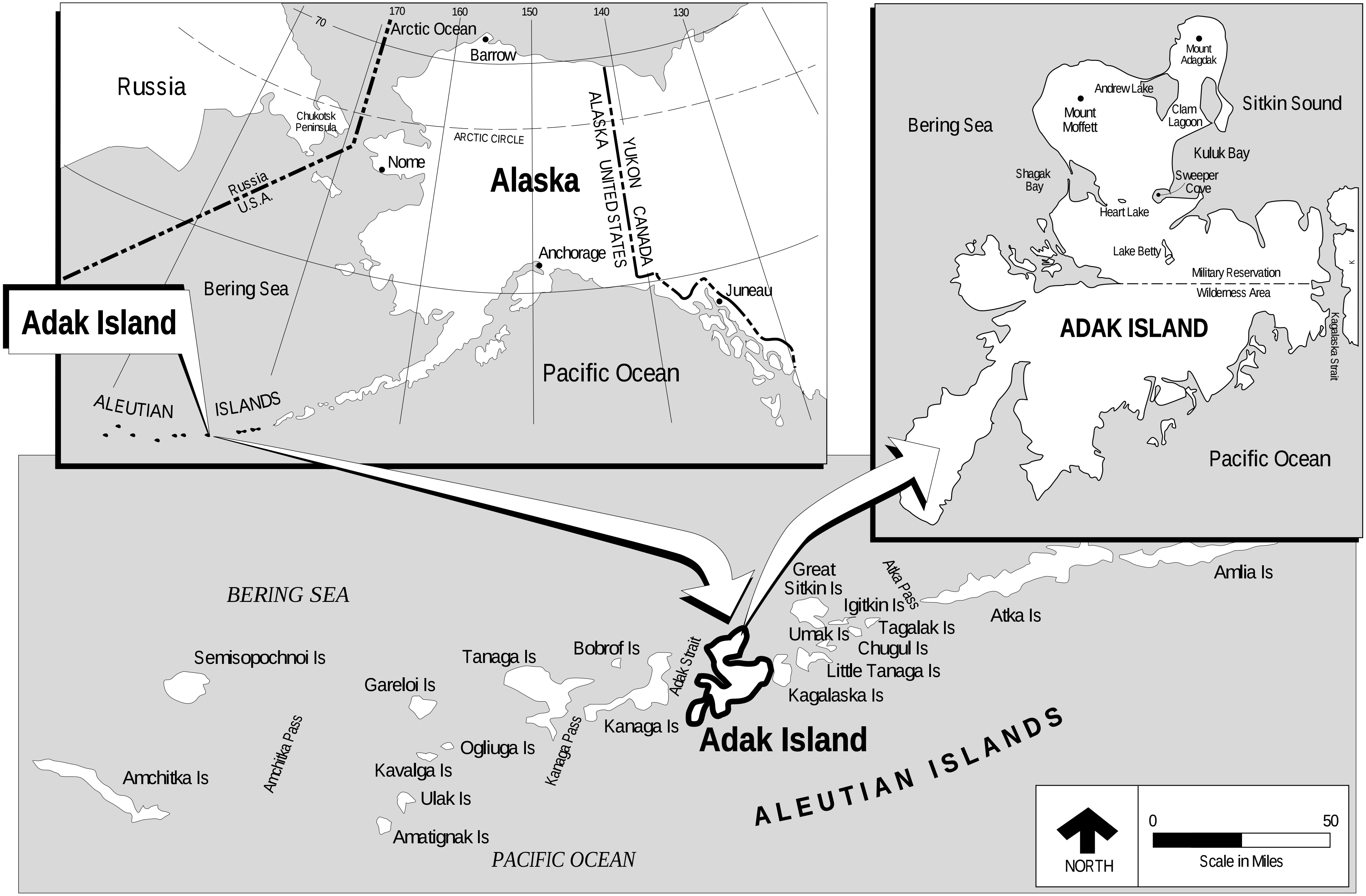
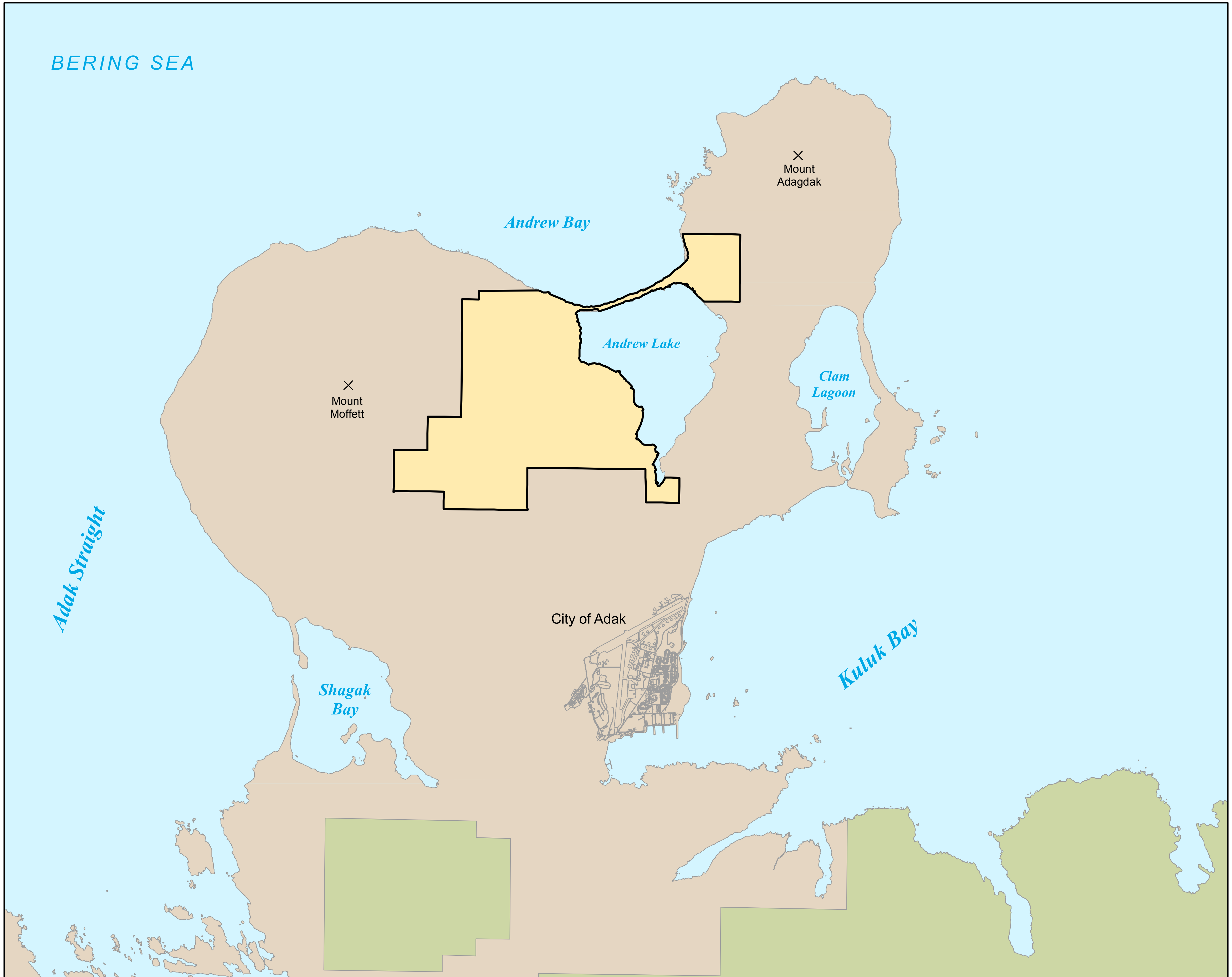


Figure 1-1
Location Map, Adak Island, Alaska



VICINITY MAP

LEGEND

- Parcel 4 Boundary
- The Aleut Corporation (TAC), City of Adak or ADOT Land
- Alaska Maritime National Wildlife Refuge (AMNWR)

N

0 1.5 3
Miles

FIGURE 1-2
Site Overview
OU B-2 Remedial Investigation Report
Adak Island, Alaska

The first Naval facility on Adak was Mitchell Field, established in March 1943. The U.S. Army established a base on the island at the same time; by the summer of 1943, about 100,000 soldiers and 100 ships were stationed at the base. Immediately after the WWII buildup of Adak to support air operations against Kiska and Attu, the military presence on the island dramatically declined. The U.S. Army controlled operations in the downtown area until 1950, when the U.S. Air Force took control of the airfield and renamed it Davis Air Force Base. The Navy conducted seaplane operations in Andrew Lake and Clam Lagoon (as well as on Mitchell Field) from 1943 to 1959, when all operations were moved to Davis Air Force Base. On August 19, 1959, Public Land Order No. 1949 designated the northern portion of Adak for use by the Navy for military purposes. The OU B-2 areas, like other ordnance areas on Adak, were used primarily during and just after WWII for military training purposes (firing ranges, target areas, etc.). Some areas dedicated for small arms training and waste ordnance disposal were used until the late 1980s; others became dormant soon after the war. Other areas of Adak were dedicated to infrastructure and support of military operations.

The Navy closed operations on Adak on March 31, 1997, but retained responsibility for Adak through the Caretaker Site Office until March 1, 2002, when the last permanently stationed, uniformed military person left the island. Approximately 65 adults and children are currently living on Adak. The Adak population increases due to temporary on-island employment, mostly because of ongoing Navy remediation efforts, seasonal fishing and hunting operations, and operation of the fish plant.

1.2.1.2 Cultural Use

The Aleutian Islands were occupied historically by the Aleut people, the Unangas. In 1741, Captain Alexei Chirikov came to Adak Island aboard the Russian vessel *St. Paul*. Adak Island was once heavily populated, but it was eventually abandoned in the early 1800s when the Aleutian Island hunters followed the Russian fur trade eastward, and famine set in on the Andreanof Group of the Aleutian Islands. Active hunting and fishing around Adak Island continued until World War II began. Numerous archaeological sites have been identified on Adak Island, and limited excavations have taken place.

In 1867, the United States purchased the Alaska Territory (including the Aleutian Islands) from Russia. The Alaska Territory represented great wealth in the form of furs and gold; however, by 1910 over-hunting and exploitation began to significantly deplete the population of fur-bearing species. In response to this concern, on March 3, 1913, President Taft established the Aleutian Islands National Wildlife Refuge under Executive Order 1733. In 1980, the name of this refuge was changed to the Alaska Maritime National Wildlife Refuge (AMNWR) (URS Consultants, Inc. [URS] 1997).

TAC expressed interest in using the existing facilities and land on Adak when the Navy closed the base. Negotiations regarding reuse of the northern portion of the island were held among TAC, the Navy, and DOI, resulting in a land exchange agreement that was executed in March 2004.

Figure 1-2 shows the current boundary of the land owned by TAC, the current boundary of the AMNWR, and the current boundary of the military reservation (Parcel 4).

1.2.2 Adak Regulatory History

In 1980, DoD established the Installation Restoration (IR) Program to address environmental contamination at defense facilities. Naval Facilities Engineering Command Northwest (NAVFAC NW) implemented the IR Program in accordance with CERCLA, which set forth regulations governing cleanup investigations and activities for hazardous waste sites. The IR Program addresses sites both on and off the U.S. Environmental Protection Agency's (EPA) National Priorities List (NPL).

Also in 1980, as part of the IR Program, the Navy adopted the Navy Assessment and Control of Installation Pollutants (NACIP) Program to address environmental contamination at naval facilities. In 1986, during the first phase of the NACIP Program, an initial assessment study (IAS) was conducted at many sites on Adak. After completion of the IAS in 1986, the NACIP Program was discontinued and replaced by EPA investigative methodologies and terminology. Site inspections and Resource Conservation and Recovery Act facility assessments were conducted in 1989 and 1991, respectively, both according to EPA guidance. A RCRA Part B permit application, providing for treatment of hazardous waste at the OB/OD-01 site, was submitted to EPA on May 11, 1991.

During the 1986 IAS, 32 sites were identified that potentially had been contaminated over a 40-year period with hazardous substances such as chlorinated solvents, batteries, and transformer oils containing polychlorinated biphenyls (PCBs). These areas included landfills, storage areas, drum disposal areas, spill sites, and pits for waste oil and firefighting training (Naval Energy and Environmental Support Activity [NEESA], 1986). Any contamination at these sites potentially posed a threat to sensitive environments both on and off the island, including the AMNWR, migratory pathways, spawning and feeding areas for fish, wetlands, and possibly the estimated 2,000 people (Adak population in 1992) living within 1 mile of hazardous waste sources (EPA, 1992).

In October 1992, NAF Adak was proposed for the NPL, and it was officially placed on the list in May 1994. The Federal Facilities Agreement (FFA), an agreement among the Navy (lead agency), EPA (regulatory lead), and the state of Alaska that specified the scope, process, and overall schedule for environmental investigations to be completed under the CERCLA process, was signed in November 1993.

The original State-Adak Environmental Restoration Agreement (SAERA) identified 26 sites requiring assessment and potential cleanup of petroleum-related contamination. The list of 26 sites has been expanded to approximately 114 sites (URS, 1996).

From 1993 through 1996, four rounds or batches of preliminary source evaluations (PSEs) were conducted. The PSE process includes a risk-based screening evaluation of human health and ecological risk at the PSE sites. Sites identified by this process as requiring additional evaluation were included in the base-wide RI/FS conducted by URS. Field work for the base-wide RI/FS began in spring and was completed in summer 1996. The final RI/FS report was published in September 1997 (URS, 1997).

In October 1995, the closure of the former Adak Naval Complex was signed into law under the Base Realignment and Closure (BRAC) Act. At that time, the Navy occupied the northern portion of the island pursuant to a public land withdrawal (Public Land Order 1,949), and the Navy began work to facilitate private-party economic reuse on Adak. Work at Adak is currently being performed under BRAC IV.

An RI/FS for OU A (for sites believed to have chemical contamination) also was conducted during 1996. This RI/FS included evaluation of three of the major drainage basins on Adak that were judged to be affected by CERCLA sites, one of which was the Andrew Lake drainage basin. The RI portion of the OU A RI/FS included sampling of water, tissue, and sediment/soil in the receiving water bodies for these drainage basins, as well as supplemental sampling. When the RI evaluation concluded, the Navy, USFWS, EPA, and Alaska Department of Environmental Conservation (ADEC) agreed that these basins were not appreciably affected by CERCLA sites (URS, 1997).

In March 1997, NAF Adak was operationally closed. It was placed in Caretaker Status, managed by NAVFAC NW, until September 2000. The Navy Caretaker Site Office managed this process.

In 1997 and 1998, a geophysical and intrusive investigation was performed in the “downtown” area of Adak Island, which was the principal focus area of private land reuse. The Navy’s objective was to complete recommended cleanup actions identified in the RI/FS and other environmental studies as quickly as possible because the military mission at NAF Adak ended on March 31, 1997.

Until April 1998, Solid Waste Management Units (SWMUs) 1, 2, and 8; SA92 (not located within OU B-2); and SA93 were the only areas on Adak thought to be extensively contaminated with MEC. SWMUs 1 and 8 and SA93 are located within the current OU B-2 AOCs. SWMU 1 is identified as the Andrew Lake Ordnance Demolition Range and is now the location of several OU B-2 sites and the open burn/open detonation (OB/OD-01) area. SWMU 8 is identified as the Andrew Lake Landfill and Shoreline and is now the location of the Andrew Lake Seawall and portions of the ALDA-01 site. SA93 is the location that contains the SA93 sites described in this RI (SA93-01, SA93-02, SA93-03, and SA93-04). A figure showing these sites can be found in the OU A ROD (U.S. Navy et al., 1999). SWMU 2 (Clam Lagoon Causeway Minefield) and SA92 (Waste Ordnance Pile Finn Field Ordnance) are not located within OU B-2. The potential SWMU 2 minefield area was cleared in 1998 under a time-critical removal action (TCRA), and SA92 was conditionally closed under the OU B-1 ROD. The Navy envisioned addressing Department of Defense Explosives Safety Board (DDESB), EPA, and ADEC concerns with regard to MEC hazards on Adak by:

- Retaining ownership of these areas and managing MEC hazards by restricting access
- Imposing focused institutional controls
- Providing an educational program to inform island residents of the nature of MEC hazards on Adak

In April 1998, archival information from WWII-era military files was discovered that indicated the area contaminated by MEC within the current military reservation on Adak may be much larger than originally believed. On the basis of this archival information, the Navy reevaluated its approach for transfer of property on Adak.

In 1998, the Navy investigated 23 areas identified as potential minefields and completed clearance of MEC at Clam Lagoon. Further investigation activities were performed in 1999 in the more remote areas of the military reservation outside of the “downtown” area. Data collected in 1999 (Draft Site Investigation [SI] Report, Foster Wheeler Environmental, 2000a), along with previously collected data and archival information, were used to prepare a Draft Preliminary Assessment (PA) Report (Foster Wheeler Environmental, 2000b). The PA Report identified areas of potential concern (AOPCs) that were screened against criteria developed by a project team that included EPA, ADEC, the Navy, and consulting members. Together with an analysis of the supporting evidence, the screening criteria were used to evaluate the likelihood and density of contamination. Results of the screening provided recommendations for moving some AOPCs to NOFA status, and for moving other sites, now labeled AOCs, forward into the RI/FS process. These evaluations are described in greater detail in Section 3 of this report.

Since 1998, the Navy has conducted several ordnance assessment and remedial actions to prepare land on Adak for public use. To facilitate transfer of the property for civilian use, the Navy also divided the military reservation into four land transfer parcels. Ordnance assessment and remediation are complete in three of the parcels, and 47,271 acres of land were officially transferred to TAC for civilian reuse.

By 2004, TAC had been working for 9 years to complete the property transfer arrangements for acquiring Adak. In March 2004, TAC received the land conveyances and personal property titles from DOI and the Navy in exchange for 47,271 acres of Alaska Native Claims Settlement Act land in the Shumagin Islands. In April 2001, Adak was incorporated as a second-class city in Alaska.

Following the PA in 2000, an OU (known as OU B) was created to manage the investigation and remediation of MEC contamination in the areas warranting further response (Foster Wheeler Environmental, 2000b). An RI/FS Work Plan (Foster Wheeler Environmental, 2000c) also was developed to facilitate a consistent investigation of the identified AOCs within OU B. This RI/FS Work Plan allowed a determination of the nature and extent of MEC contamination in each area, as well as the collection of data needed to support hazard assessment and decision making with regard to the remediation of MEC.

The Navy began implementing this RI/FS Work Plan in 2000. By the end of the first field season, the Navy recognized that certain areas of the military reservation (primarily those in Parcel 4 areas) would require an extended period of time for assessment and remediation because of the nature of the contamination and/or the lack of an effective technical approach for remediation. In order to expedite the assessment and cleanup of those portions of the military reservation that could be transferred in a timely manner, OU B was divided into two parts: OU B-1 and OU B-2. OU B-1 contained the AOCs that were slated for transfer to TAC as part of the land transfer agreement. These AOCs and surrounding property were contained in Land Transfer Parcels 1 through 3. OU B-2 contained the remaining AOCs that were expected to require an extended period for remediation. These AOCs and surrounding buffer areas were contained in Land Transfer Parcel 4, which is slated for relinquishment to the DOI.

The final Land Transfer Parcel (Parcel 4), shown on Figure 1-2, contains the AOCs within OU B-2. Remediation of ordnance contamination in this land transfer parcel is not yet complete. An RI/FS report was begun for OU B-2 in 2002; in 2006, the Project Team agreed that additional site characterization was necessary to fill data gaps so that remedial alternatives could be developed. The RI Work Plan (TetraTech, 2008) presented the activities and assessment protocols needed to fill the data gaps and complete the RI process and associated hazard assessments for the OU B-2 sites. The work set forth in the RI/FS Work Plan is complete except for finalization of the RI/FS report.

1.2.3 Regulatory Drivers

The OU B-2 RI/FS project is being conducted under the BRAC Environmental Restoration Program for NAF Adak. The U.S. Navy intends to relinquish the parcel containing OU B-2 upon completion of the RI/FS process, proposed plan, ROD, and required remedial actions. The reasonably anticipated future land uses are expected to be wildlife management, subsistence (fishing and hunting), research, and recreation.

The principal regulatory driver for the RI/FS is CERCLA 120. This is because NAF Adak was placed on the CERCLA National Priorities List (NPL) in May 1994, prior to identification of the base for closure under the BRAC Environmental Restoration Program. The Adak Federal Facilities Agreement (FFA) of 1993 specified the scope of work for this CERCLA site. Under DoD guidance on CERCLA 120(h) compliance, existing cleanup authorities and programs must be used to evaluate the need for remedial action. Therefore, the federal land transfer process under CERCLA 120(h) does not create an additional or overriding procedure for evaluating the need for remedial action.

Under CERCLA 120 and Executive Order 12580, the Navy is the lead agency responsible for the cleanup effort. EPA Region 10 and the Alaska Department of Environmental Conservation (ADEC) provide oversight. This oversight includes participation on the OU B Project Team, which consists of representatives from the Navy, ADEC, EPA, U.S. Fish and Wildlife Service (USFWS), and consultants for the various members. The project team was formed to facilitate the development of a site-specific CERCLA process for assessing and remediating MEC on Adak. It provides a forum for data input, discussion, and issue resolution.

One of the AOCs located in OU B-2, OB/OD-01, is also regulated under the Resource Conservation and Recovery Act of 1976 (RCRA) because it was identified as a hazardous waste treatment unit in a RCRA Part B Permit application submitted to EPA in May 1991. Although a RCRA Part B Permit was never issued, OB/OD-01 is considered an interim status site because RCRA activities, including treatment of RCRA-regulated wastes, occurred and therefore, OB/OD-01 is subject to the substantive closure and post-closure care requirements of RCRA.

1.2.4 Munitions-related Terminology

Since some of the munitions work on Adak Island began, the terminology used for munitions work has changed. In previous documents prepared for Adak, the terms ordnance and explosives (OE), abandoned ordnance, unexploded ordnance (UXO), OE waste, and OE scrap were used to describe the various types of ordnance and their related items. Because reference materials may still include old terminology, Table 1-1 provides a cross reference for the reader’s convenience:

TABLE 1-1
Munitions Terminology Cross Reference

Terminology	MEC				MPPEH	
Report Term	MEC	UXO	DMM	MC	MD	RRD
Old Term	OE	UXO	AO	None	OE scrap	OE waste

AO = abandoned ordnance
DMM = discarded military munitions
MC = munitions constituents
MD = munitions debris
MEC = munitions and explosives of concern
MPPEH = material potentially presenting an explosive hazard
OE = ordnance and explosives
RRD = range-related debris
UXO = unexploded ordnance

It should be noted that munitions identified during previous investigations on Adak were sometimes referred to by common or slang terms that are not technically correct (e.g., round, rifle grenade, pop-up flare). To address this problem during the RI, field personnel were instructed to use the U.S. Army 43-0001 series publications as a reference for identification of all munitions found. In addition, it appears that a small number of items located were incorrectly identified. In the interests of accuracy and clarity, an effort has been made to research the correct designations for some types of items previously identified by slang terms or misidentified.

1.2.5 Adak-specific Terminology/Definitions

Adak has a unique physical environment in that the tundra that covers much of the island forms a thick, spongy rootmat that cannot be penetrated without cutting or digging. As such, it has been difficult in the past to determine where the ground surface is and how this location relates to munitions operations. To eliminate issues regarding the term “surface,” the Project Team developed a site-specific definition. The “surface” for Adak is specifically defined as the top of mineral soil beneath the vegetation layer. This surface is sometimes located several inches below the walking surface because of the thickness of tundra vegetation growing in some areas of Adak.

1.2.6 Community Relations

In July 1999 (under the provisions of the existing FFA for cleanup of the former Adak Naval Complex), to address issues of concern, the Navy, EPA, and ADEC formed the Project Team. The team included representatives from the Navy, EPA, ADEC, USFWS, TAC, and the Aleutian/Pribilof Islands Association, Inc. (A/PIA). In addition, experts in the field of UXO investigation, cleanup, and community relations provided technical support. The Project Team was tasked with developing a plan for investigating sites with potential UXO contamination, and to consider the concerns of regulatory agencies, community members, TAC, and future users of Adak Island. That plan is formally referred to as the RI/FS Work Plan for OU B. EPA and ADEC approved the plan in December 2000.

Early on, the Project Team generally convened on a monthly basis, with regular teleconferences and e-mail communication among its members. The Project Team also met with the Restoration Advisory Board (RAB) and held open houses to invite community input. In addition, a cooperative agreement between the Navy and A/PIA was developed to facilitate A/PIA’s participation as a member of the Project Team. More recently, the Project Team structure has changed slightly, with less active involvement by A/PIA and TAC, and the team has not met as regularly. However, the Navy has continued to liaise with stakeholders to address their concerns and involve them in the planning for the OU B-2 RI/FS.

1.2.6.1 Information Repositories

The Information Repository, which includes a copy of the Administrative Record and all documents used by the parties under the FFA, is located at the University of Alaska, Reserve Room, 3211 Providence Drive, Anchorage, Alaska, and is open to the public. The official copy of the Administrative Record is located at NAVFAC NW, 1101 Tautog Circle, Silverdale, Washington. An additional information repository is also located on Adak in the Bob Reeves High School. The Administrative Record includes all the documents used by the parties under the FFA to make decisions regarding Adak remediation.

1.2.6.2 Community Relations Plan

The Community Relations Plan (CRP) formalizes the process for involving the Adak Island community, interested members of the public, and the extended community in environmental restoration and property reuse. The first CRP was prepared in 1993 and was revised several times, the last time in 2003. The Navy is planning to update the CRP in the future.

1.2.6.3 Restoration Advisory Board

The RAB was formed in 1996 to advise the Navy on decisions concerning cleanup on Adak. Individuals interested in becoming members of the RAB filled out applications, and all of the applicants were accepted as RAB members. The group consists of private citizens and representatives of various organizations, including TAC, the Adak Reuse Corporation, and the Adak City Council. Members of the A/PIA, which is the designated representative for the federally recognized Aleut Tribal interests, and other Aleut community members have also been active participants in the RAB. In addition, A/PIA and the Navy have entered into a cooperative agreement to facilitate

A/PIA's participation in matters related to the environmental cleanup on Adak. In the spring of 1999, the RAB received a grant for a technical adviser to review documents and provide technical support.

Currently, the RAB meets approximately every 6 months, typically in Anchorage, Alaska. Other interested parties and local RAB members on Adak participate by telephone. The RAB will continue to be a vehicle for informing the public about ongoing remediation and future plans. The Navy maintains a mailing list of RAB members that consists of approximately 25 names.

1.2.6.4 Fact Sheets and Newsletters

Numerous fact sheets and newsletters relating to the cleanup work on Adak have been distributed since 1993. Since 1999, either a joint Navy, EPA, and ADEC newsletter called *Adak Update* or a fact sheet from the Navy has been distributed to the individuals and groups on the general mailing list found in the revised CRP. Copies of the newsletter and fact sheet are sent to the information repository on Adak Island.

1.2.6.5 Open Houses

A series of open houses has been held on Adak and in Anchorage, which has allowed project managers and Project Team members to be available on a one-on-one basis to answer questions from the public. These open houses started in 1993 and have been held in 1994, 1998, 1999, and three times in 2000. Additionally, an open scoping meeting was held in 1995, after Adak was placed on the BRAC list, to discuss the closure and its implications. The open houses generally coincided with RAB meetings.

1.2.6.6 Information Line and Web Site

To proactively support the Local Reuse Authority and the RAB, the Navy established an information line (1-866-239-1219), which RAB members and citizens interested in reuse or environmental restoration of Adak can call. The line connects the caller to NAVFAC NW. A Navy staff person answers the caller's question or the caller may leave a message regarding questions or concerns. Messages are retrieved daily and responses are made as soon as possible, generally within 3 days.

A project Web site, www.adakupdate.com, is on-line. The site is easily accessed through common Internet search engines and comes up in the top 10 sites when "Adak" is searched. Although the site is fully developed, information is still being added. The Web site contains all the project newsletters, presentation materials prepared for RAB, fact sheets, and news releases. The Web site also provides an opportunity for stakeholders to interact with Project Team members through e-mail. Links to technical documents are provided. Information on RAB meetings, public meetings, and open houses, as well as links to state and federal agency sites, is also provided. The Web site also provides an interactive opportunity by allowing the public to e-mail the Web manager, who then forwards the comments and/or questions to appropriate resources. To date, there have been numerous such public interactions resulting from the Web site. This site has become a principal point of distribution for documents, newsletters, and information on the Adak project.

All relevant Adak documents remain available as part of the Administrative Record in the designated information repository locations stated in Section 1.2.6.1.

1.2.6.7 Public Comment

Public comments also have been solicited through informal avenues such as hot lines, open houses, and RAB meetings; via the Internet; and through formal public comment periods. Proposed plans and other documents that require public comment are posted as required, and they are typically advertised in the *Anchorage Daily News*. In addition, copies are made available at public meetings and RAB meetings; through a mailing list; in the Administrative Record at NAVFAC NW in Silverdale, Washington; and in the Information Repository at the University of Alaska in Anchorage.

Participation in the RAB by members of the public has fluctuated over time. Current (2012) participation by community members is excellent. The Navy also retains a community liaison to communicate current issues with the public outside of the formal community meeting format. The Navy believes this form of communication has been more effective in the recent past than formal meetings.

1.2.6.8 Stakeholders

The primary stakeholders have been identified as follows:

Federal Agencies

- U.S. Environmental Protection Agency
- U.S. Department of the Interior, U.S. Fish and Wildlife Service
- U.S. Coast Guard

State Agencies

- Alaska Department of Environmental Conservation
- Alaska Department of Natural Resources
- Alaska Department of Transportation

Local Government Agencies

- Adak City Council
- City of Adak
- Aleutian Region School District

Native Organizations and Individuals

- Aleutian/Pribilof Islands Association, Inc.
- The Aleut Corporation
- Adak Enterprise Corporation
- Adak residents
- Mayor, Adak City

Companies and Other Business Interests

- Fishery industry representative
- Environmental groups
- Icicle Seafoods

1.3 Report Organization

This report is composed of an Executive Summary and the following sections, which cover the required elements for site characterization and risk assessment in an RI report:

- Section 1 – Introduction
- Section 2 – Physical Characteristics of the Study Area
- Section 3 – Previous Investigations
- Section 4 – Adak CSM, AOC Characteristics, and 2008 RI Data Gaps
- Section 5 – 2008 Investigation
- Section 6 – Additional Work (2008 – 2012)
- Section 7 – Nature and Extent of Contamination
- Section 8 – Explosives Safety Hazard Assessment
- Section 9 – Chemical Risk Screening Assessment
- Section 10– Conclusions and Recommendations
- Section 11 – References

Maps and tables referenced in the text are provided in the body of the report. Appendices containing detailed information about the RI are appended to the text, as follows:

- Appendix A – Reconnaissance Reports
- Appendix B – Intrusive Summary
- Appendix C – MEC Field Documentation (electronic only)
- Appendix D – MC Field Documentation (electronic only)
- Appendix E – Laboratory Data and Validation Reports (electronic only)
- Appendix F – GIS Data (electronic only)
- Appendix G – Historical Environmental Photographic Analysis (electronic only)
- Appendix H – Cultural Resources Survey Report (electronic only)
- Appendix I – Wetland Delineation Report (electronic only)
- Appendix J – Candidate, Threatened and Endangered Species and Survey of Associated Habitats Report (electronic only)
- Appendix K – ESHA Methodology
- Appendix L – Risk Assessment Information

Electronic-only appendixes are provided on the enclosed DVD.

SECTION 2

Physical Characteristics of the Study Area

This section describes the general physical characteristics of the OU B-2 study area, including climate and weather, topography, hydrology, geology, groundwater, land use, and ecology.

2.1 Climate and Weather

Adak Island has a polar maritime climate characterized by persistent overcast skies, high winds, frequent and often violent storms, and a relatively narrow range of temperature fluctuation throughout the year. Adak is located in the region of the polar front, the zone of convergence between temperate westerly winds (which actually blow from the southwest at this latitude) and polar easterly winds. In the area of the Aleutian Islands, this interface of air masses creates a semi-permanent, low-pressure zone, which is particularly strong in the winter and generates the frequent low-pressure (cyclonic) storms characteristic of the North Pacific region.

Weather on the island can be very localized; fog, low ceilings, precipitation, and clear weather can occur simultaneously within a few miles of each other. Storms occur during all seasons, with the most frequent and severe storms during winter. The average total annual precipitation for Adak Island (measured at the airport) is about 152 centimeters (cm) (60 inches), most of which falls as rain in the lower elevations. Average monthly precipitation varies from a low of about 7.6 cm (3 inches) during June and July to a high of 17.8 to 20.3 cm (7 to 8 inches) during November and December.

Snowfall averages more than 254 cm (100 inches) a year at sea level, but because of the relatively warm temperatures, snow depth rarely exceeds 0.3 to 0.6 meter (m) (1 to 2 feet [ft]). The snow level (the elevation at which precipitation falls as snow instead of rain) varies with the temperature. Typically, snow occurs on Adak Island between November and April, but it melts fairly quickly at elevations less than 305 meters (1,000 feet) above mean lower low water (MLLW). At elevations greater than 305 meters above MLLW, snow that falls between November and April generally remains as snowpack throughout the winter. Between May and October, snow rarely falls at sea level. From June through September, snow melts in the higher elevations, augmenting streamflow, and most precipitation falls as rain over the entire island. Permanent snowpack is not typical in the OU B-2 sites because most of the sites are at lower elevations.

Wind conditions are typified by local directional shifts and rapid changes in velocity. Average wind velocity is 12 knots, with gusts in excess of 100 knots recorded during winter storms. High winds, with gusts over 50 knots, are frequent during the summer months.

Monthly temperatures range from a low of 32.9 degrees Fahrenheit (°F) (0.5 degree Celsius [°C]) in February to a high of 51.3°F (10.7 °C) in August. The highest recorded temperature for Adak Island is 75°F (23.8°C) (recorded in August 1956), and the lowest recorded temperature is 3°F (-16.1°C) (recorded in January 1963 and again in February 1964).

2.2 Surface Features and Topography

The topography of northern Adak Island is directly related to its volcanic origin, with few areas of flat land. The western portion of the Range Complex at Andrew Lake (Figure 2-1) is a valley surrounded on three sides (north, west, and south) by steep slopes leading upward to Mt. Moffett. The valley is drained primarily by Moffett Creek, which forms a small alluvial plain adjacent to Andrew Lake. A number of small ponds and wetland areas are distributed around the eastern portion of the Range Complex at Andrew Lake. The topography of the Andrew Bay Seawall Area is somewhat similarly configured, with the C1-01 area being an upland surrounded by steep cliffs and drainages leading to Andrew Bay and Andrew Lake (Figure 2-2). The seawall itself (ALSW-01) is a man-made berm constructed of large rocks and boulders. Topography in the vicinity of the SA93 area is characterized by a broad upland drained primarily by Mitchell Creek (Figure 2-3). The ground surface along the western and southern perimeter of the SA93 area slopes steeply downward to Andrew Lake and Andrew Bay.

2.3 Hydrology

The surface water hydrology in the vicinity of the OU B-2 sites is characterized by several short, steep-gradient streams draining radially from Mt. Moffett and Mt. Adagdak. One major stream, Moffett Creek, drains off Mt. Moffett into the valley on the western side of Andrew Lake and runs through the valley where many of the OU B-2 sites are located. A smaller, unnamed creek drains the in the northern part of the Range Complex at Andrew Lake, where RR-02 and SA-01 are located. The locations of Moffett Creek and the unnamed creek are shown in Figure 2-1. On the eastern side of Andrew Lake, a smaller drainage, Mitchell Creek, runs through the sites located in the SA93 area from north to south and drops down a steep ravine to Andrew Lake. The locations of Mitchell Creek and other drainages in the SA93 area are shown in Figure 2-3. Moffett Creek and Mitchell Creek remain active throughout the year, although the flow may fluctuate seasonally based on snowpack and snowmelt, rainfall, and surface or shallow groundwater drainage. Several small ponds or marshy areas exist seasonally or year-round in the lower elevations.

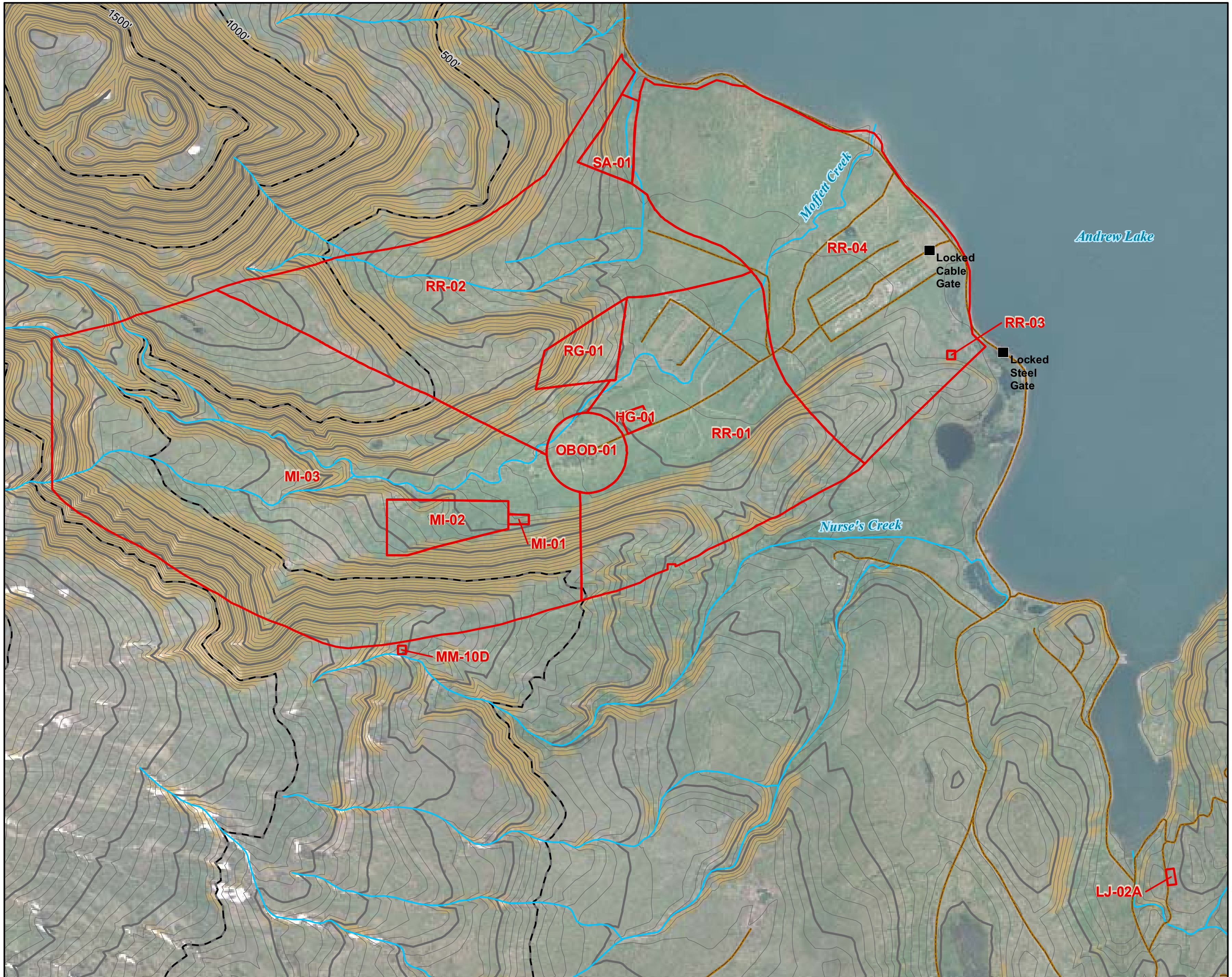
Perennial flow is maintained by snowmelt in the mountains and groundwater seepage from the shallow surficial soils. Numerous lakes and sediment deposits occur along stream courses. Andrew Lake is the largest freshwater body near OU B-2 and borders some of the AOCs. Andrew Lake drains into Andrew Bay via a spillway on the northwest corner of the lake. Due to large rock and cobbles blocking the entrance to the spillway, there is no access for migratory fish into Andrew Lake except after periodic clearance of the large rocks, metal, wood, and vegetation that block the spillway. Andrew Bay is a marine environment with a high-energy beach susceptible to heavy surf.

Surface water runoff is the principal geomorphic process that changes the surface features of the Andrew Lake drainage basin, and the streams that radiate off the upper elevations typically respond quickly to precipitation events unless the precipitation falls as snow and is stored as such. The primary Mt. Moffett drainages originate at higher elevations (greater than 457 meters [1,500 feet]) and accumulate significant snowpack during the winter. Melting of this snowpack often provides perennial flow throughout the summer. These streams provide shallow throughflow in surficial soils and groundwater in alluvial deposits.

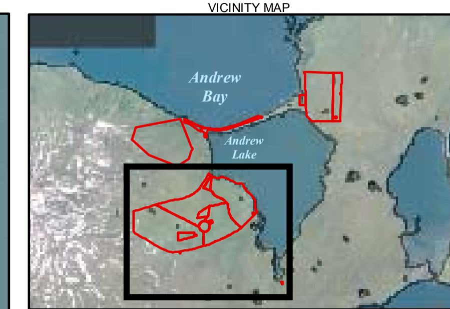
Evapotranspiration on Adak has been estimated by using the EPA Hydrologic Evaluation of Landfill Performance model. However, evapotranspiration on Adak has not been calculated by public or private entities to date. The hydrologic evaluation within the Andrew Lake drainage basin was confined primarily to Moffett Creek Valley because, at 2,800 acres, it is the largest watershed and composes approximately 38.5 percent of the land area in the basin. On July 2, 1993, the U.S. Geological Survey (USGS) established a recording streamflow gauging station near the mouth of Moffett Creek, as well as a recording precipitation gauge at an elevation of 6.1 meters (20 feet). A rating curve for this gauge has been calculated assuming a consistent correlation between stage and flow over time. In July 1994, miscellaneous streamflow measurements also were taken at the mouth of Nurses Creek (drainage area 1,152 acres) and Mitchell Creek (drainage area 512 acres). Nurses Creek is located outside the area (to the south) of the OU B-2 sites.

During the period January 1, 1992, through July 31, 1994, precipitation within the Moffett Creek drainage basin averaged approximately 2.43 million cubic feet (mcf) per day. Average streamflow was estimated at 2.89 mcf per day. Potential evapotranspiration was calculated at 0.40 mcf per day. On the basis of these data, approximately 0.86 mcf per day discharges from Moffett Creek above what is accounted for by precipitation minus potential evapotranspiration, a 42 percent differential. In addition, studies show that unconfined groundwater exists within the alluvial channel of lower Moffett Creek. This differential could be partially accounted for by some or all of the following:

- A higher rate of precipitation falling in the upper slopes of Mt. Moffett that is not measured by the gauge
- Net loss of storage from the snowpack on Mt. Moffett
- Wind-redistributed snow accumulating in the Moffett Creek drainage basin
- A low bias to the rating curve for Moffett Creek
- A high estimate for actual evapotranspiration in this basin



VICINITY MAP



LEGEND

- Gate
- 20-ft Contour
- 100-ft Contour
- 500-ft Contour
- Stream
- Road
- Area of Concern (AOC)
- Slopes Greater Than 30 Degrees (as calculated from terrain model)

Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

N

0 600 1,200
Feet

FIGURE 2-1
Topography and AOCs –
Range Complex at Andrew Lake
OU B-2 Remedial Investigation Report
Adak Island, Alaska

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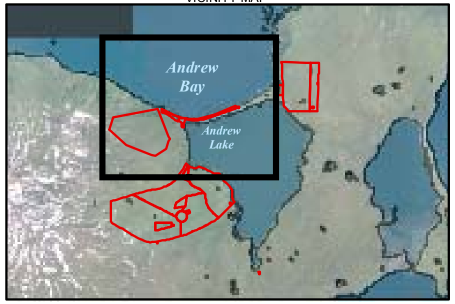
VICINITY MAP



LEGEND

- Gate
- 20-ft Contour
- 100-ft Contour
- 500-ft Contour
- Stream
- Road
- Area of Concern (AOC)
- Slopes Greater Than 30 Degrees (as calculated from terrain model)

Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

N

0 600 1,200
Feet

FIGURE 2-2
Topography and AOCs – Andrew Bay Seawall Area
OU B-2 Remedial Investigation Report
Adak Island, Alaska

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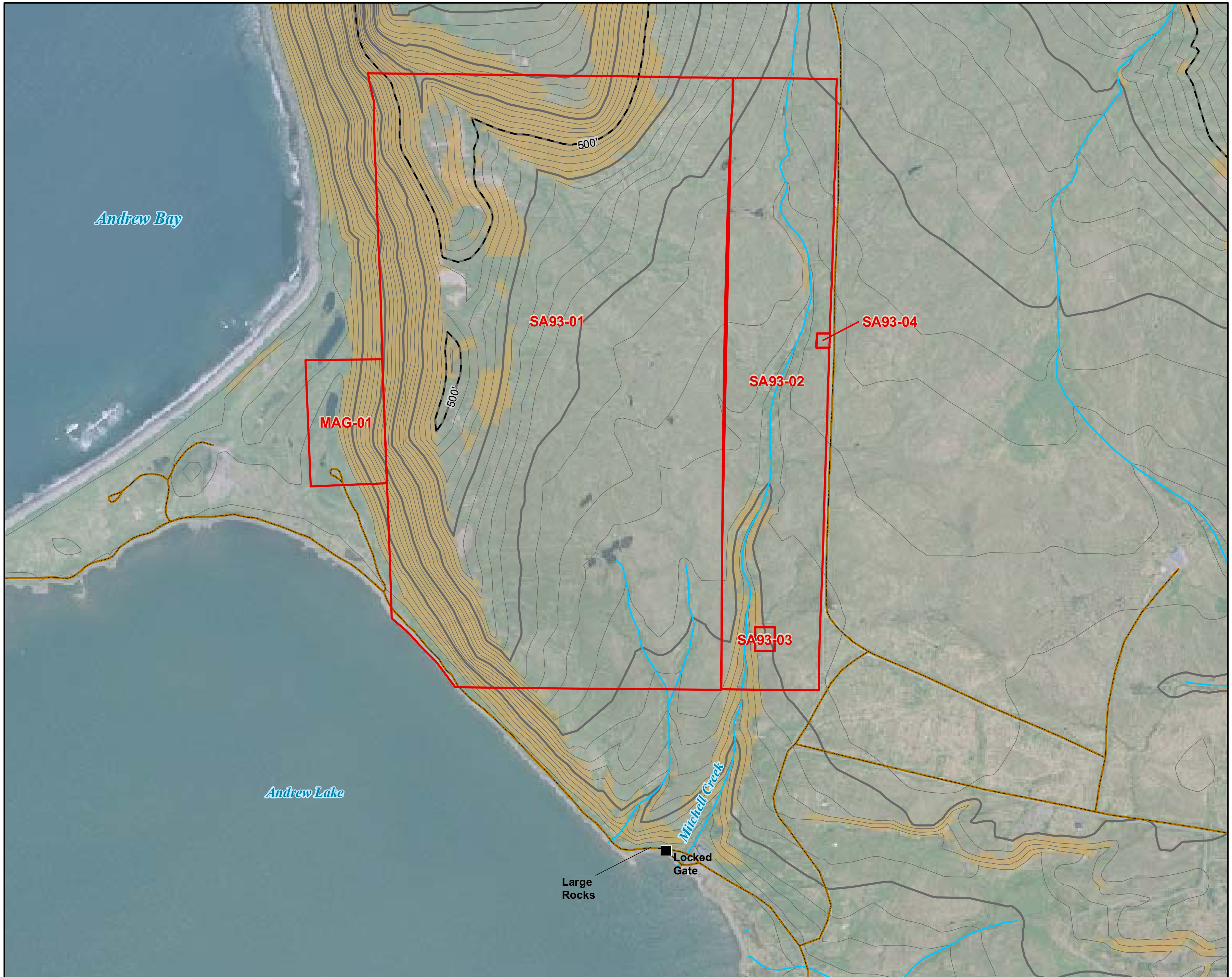
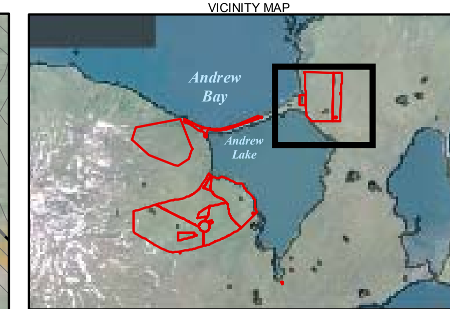




LEGEND
- Gate
- 20-ft Contour
- 100-ft Contour
- 500-ft Contour
- Stream
- Road
- Area of Concern (AOC)
- Slopes Greater Than 30 Degrees (as calculated from terrain model)

Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

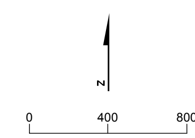


FIGURE 2-3
Topography and AOCs – SA93 Area
OU B-2 Remedial Investigation Report
Adak Island, Alaska

Regardless of the causes, the data indicate that very little groundwater recharge occurs within the Moffett Creek drainage basin. Nearly 100 percent of precipitation less evapotranspiration leaves the watershed as overland flow via Moffett Creek. The low permeability of the soils and underlying lithology promote direct runoff rather than infiltration (TetraTech, 2008). This scenario is typical of most drainages on the island. When this assumption is applied to the remainder of the basin, an estimated average of approximately 5.27 mcf per day discharges into Andrew Lake as overland flow via Moffett Creek, Nurses Creek, Mitchell Creek, and several other minor drainages. Groundwater recharge is considered negligible within this basin.

2.4 Geology, Soils, and Geologic Processes

Adak Island was formed by geologic events that included volcanic eruption and tectonic subduction (movement of the oceanic crust toward and beneath the continental crust). Advancing and receding glaciers, frequent rainfall, and high winds have shaped Adak Island into dramatic hills, valleys, cliffs, and floodplains. The highest point on Adak Island is Mt. Moffett (elevation approximately 1,181 meters [3,875 feet]), and some cliffs on the island rise 762 meters (2,500 feet) above sea level. The majority of the island is underlain by a thick (estimated at 2,438 meters [8,000 feet]) sequence of rock, designated the Finger Bay volcanics (Coats, 1956). This material was developed 50 to 60 million years ago as a result of an outpouring of lava, primarily below sea level.

More recently, a relatively thin layer (generally less than 3 meters [10 feet]) of surface material covered much of the bedrock of Adak Island, and only the downtown area is known to have accumulated a thick (greater than 30.5 meters [100 feet]) sequence of unconsolidated sediments. The primary source of sediment is weathered volcanic bedrock and volcanic material. The surface deposits originated primarily through three geological processes: glaciations, volcanic activity, and erosion and deposition of the resulting sediments into lower-lying areas. These sediments are classified by their mode of transport or depositional environment.

The surficial geology and hydrogeology of Adak were investigated in 1994 and 1995, in cooperation with the Navy and USGS. This study resulted in the creation of a surficial geologic map of selected areas on the northern half of the island. Surficial deposits studied on the northern half of Adak Island include a variety of volcanic, glacial, eolian (wind-blown), and beach sediments. These deposits are the principal water-bearing units on the island (Waythomas, 1995).

2.4.1 Parcel 4 Geology and Soils

The geology of Parcel 4 on the west side of Andrew Lake consists primarily of deposits of tephra that overlie undifferentiated alluvial (river) deposits. This area generally is composed of debris flow deposits, which consist of poorly sorted, matrix- and clast-supported, angular bouldery gravel. Discrete areas on the west side of Parcel 4 are composed of modern stream alluvium that consists of well-sorted to moderately sorted, angular to rounded gravel; sand; and minor silt along present-day streams and creeks. Other areas on the west side of Parcel 4 are composed of delta deposits that consist of alluvium deposited at the confluence of a river and standing water. The deposits consist of moderately sorted sand and gravel usually overlain by tephra, indicative of formerly higher lake levels.

Parcel 4 areas on the east side of Andrew Lake contain a medley of geologic units. They are mainly composed of debris flow deposits, consisting of poorly sorted, matrix- and clast-supported, angular bouldery gravel and perhaps consisting of reworked lahar deposits, colluvium, and talus. Isolated areas here are composed of landslide deposits, which are composed of discrete bodies of reworked, unconsolidated sediment formed by slumping, sliding, or short-distance debris flow. These bodies consist of poorly sorted to intact blocks of soil and sediment found, generally, a short distance from the source. Discrete sites within this area are composed of unsorted, massive, matrix-supported, cobble and boulder gravel. The matrix consists of silt, clay, and fine sand. The thickness of deposits varies from 1 to 15 meters (39 to 590 inches [in.]). Other discrete sites within this area are composed of undifferentiated bedrock outcrops, which may include minor amounts of talus and colluvium.

2.4.2 Frost Heave

Frost heaving (or frost heave) occurs when soil expands and contracts due to freezing and thawing. On Adak Island, it has been determined that frost heave is not a significant consideration when evaluating the possible migration of MEC at locations below 305 meters above sea level (asl) (1,000 feet), primarily because of the lack of subfreezing temperatures in the soil below this elevation. This assumption is based on a frost heave study conducted in 2001 (Beagle Folsom Research and Testing, 2001). Results of this study are summarized in Section 3.9.

2.4.3 Mass Wasting and Erosion

During past field work on Adak, some localized slumping, landslides, or small-scale debris flows have been observed and noted in some areas, including several OU B sites (C1-01, SA93-01, and MI-03), and were noted mainly in association with areas that have relatively steep slopes. Erosional features that may be found on Adak may come from natural processes such as weathering from wind, frost action, or water action, and occasionally from seismic activity. Human activity can also induce mass wasting and erosion processes in areas that become disturbed, such as where road cuts are made, buildings are placed, or vegetation is otherwise disturbed.

Mass wasting is the downslope movement of earth materials under the influence of gravity. Mass wasting may be present in several forms, including slumps or landslides, or slower progressions such as soil creep; it is typically present along steeper slopes. However, a variety of complex factors, in addition to slope, can influence the susceptibility of the land to mass wasting. The geology of the area, soil type, depth of underlying bedrock, vegetation cover, presence of frost heave susceptibility (climate and elevation, freeze/thaw cycles), as well as surface water and groundwater presence, can all influence the degree of mass wasting that may be expected. Mass wasting might also occur in areas where gullies have formed, such as steeper creek drainages. Frost heave is discussed in Section 2.4.2.

2.4.4 Earthquakes

Adak Island is adjacent to and overlying a zone at the boundary of the Pacific and the North American crustal plates where the edge of one plate moves under the other. Seismic activity along the Aleutian Islands is considerable, and several large earthquakes have occurred in the vicinity of Adak Island. The last three major earthquakes in the area occurred on June 9, 1996, in the Aleutian Islands (magnitude 7.7 on the Richter scale); on May 7, 1986, in the Andreanof Group of the Aleutian Islands (magnitude 8.0 on the Richter scale); and on March 9, 1957, in the Aleutian Islands (magnitude 8.6 on the Richter scale) (URS, 1997). USGS maintains seismic sensing equipment on the island. The University of Colorado maintained a seismic station on Adak until 1992. A strong earthquake (generally one registering a magnitude greater than 6.3 on the Richter scale) may cause a shifting of surficial geology.

Earthquakes have the potential to trigger landslides, slumps, or rock fall on land where steep slopes are located, and they can also trigger slides and debris flows under water where the land slopes steeply to the marine floor.

2.5 Groundwater

Groundwater on Adak Island occurs predominantly in areas of high permeability, such as artificial fill or beaches, and in low-lying areas, such as deposits laid down by water or wind. Groundwater also occurs in the upland areas of coarse-grained volcanic deposits that are often characterized by fragments of rocks ejected during eruptions. Smaller amounts of groundwater also occur in localized deposits and within fractured bedrock. No aquifer or significant quantity of groundwater exists where deposits of fine-grained volcanic ash overlie bedrock. Groundwater is not used as a source of drinking water anywhere on Adak Island.

Much of the upland area, such as Mt. Moffett, is covered by a composite layer of weathered volcanic ash that generally minimizes the amount of rain or snow that permeates deeper than the vegetative mat on its surface. If the layer of soil under the vegetation is thin, precipitation tends to run off as surface water or streamflow. If the soil under the mat of vegetation is thicker, precipitation penetrates the soil until it reaches the ash layer. At that point, the precipitation becomes shallow groundwater that flows beneath the vegetative mat toward discharge areas such as springs or seeps. Underlying the ash layer may be deposits of volcanic gravel known as lahar. Bedrock underlies the ash layer in some areas.

Significant water-bearing units in the Andrew Lake drainage basin are limited to the alluvium-filled valleys of Moffett, Nurses, and Mitchell creeks. Groundwater is also believed to flow across the seawall between Andrew Lake and Andrew Bay; however, no intrusive hydrogeologic investigations have been conducted either in the upper Moffett Creek Valley or along the seawall. It is likely that groundwater flow to the north of Andrew Lake is to the south across the seawall toward Andrew Lake. Limited groundwater investigations have been conducted in lower Moffett Creek. The findings and conclusions of the investigations are summarized below.

The Moffett Creek Valley is an alluvium-filled, V-shaped valley near the base of Mt. Moffett. The valley walls are sloped at about 1 vertical to 2.5 horizontal and are composed of andesitic basalt and consolidated ash tuff. The only site-specific subsurface information available for the valley is from two shallow, hand-augered borings, 2.3 and 3 meters (7.5 and 10 feet) below ground surface (bgs) (Hart Crowser, 1993) and from shallow (up to 4.3 meters [14 feet]) borings advanced for temporary monitoring well installation during the 2008 RI (see Section 5). The valley floor is composed primarily of alluvial, silty, gravelly sand with an estimated average thickness of 10.6 meters (35 feet). These alluvial deposits overlie andesitic basalt bedrock and consolidated ash tuff. A thin, 0.6- to 1.2-m (2- to 4-ft) mantle of vegetative mat covers the surface of the valley.

On the basis of a boring log and groundwater measurements from the piezometers and temporary monitoring wells, the alluvium is assumed to contain an unconfined saturated unit with a water table near the surface (about 1.8 meters [6 feet] bgs). On the basis of stage measurements along Moffett Creek, groundwater is in hydraulic communication with the creek (Hart Crowser, 1993), with some reaches of the stream gaining and some losing. Mt. Moffett bedrock is expected to be relatively impermeable and will form no-flow boundary conditions at the valley walls and beneath the alluvium outwash found in the Moffett Creek and Mitchell Creek valleys.

Groundwater recharge is primarily from streamflow, originating on the upper flanks of the mountain and, to a limited degree, from direct precipitation and infiltration. Groundwater discharges directly to Andrew Lake or indirectly to Andrew Lake via Moffett Creek. Previous studies concluded that groundwater accounts for a relatively small fraction of the total discharge to Andrew Lake from the Moffett Creek Valley (Hart Crowser, 1993). A similar relationship between surface water and groundwater discharge is likely for the Mitchell Creek Valley.

Conclusions regarding groundwater hydrology were based on the soil characteristics as reported in soil borings, on historical groundwater levels measured in one of the piezometers installed by Hart Crowser (PZ-1), and on surface topography. Unconfined groundwater flow direction is approximately parallel to the surface contours and is to the northeast, where groundwater eventually discharges to Andrew Lake. The estimated groundwater gradient (i) is equal to the surface topography (-0.025). The estimated hydraulic conductivity (K) ranges from 10 to 20 feet per day, which is typical for unconsolidated alluvium/outwash (Fetter, 1998; Freeze and Cherry, 1979; Carcel and Parrish, 1988), and the porosity (η) is estimated to be 0.3. Average linear groundwater velocity (v) ranges from 0.18 meters to 0.36 meters (0.6 to 1.2 feet) per day. Groundwater discharge from this alluvial aquifer is calculated at approximately 30,000 cubic feet per day. The hydrologic budget does not indicate the availability of this much water to recharge groundwater in this valley. However, it has been determined that rainfall on the higher elevations of Mt. Moffett may be greatly underestimated from gauges located near sea level. An additional 6 to 8 in. (15.24 to 20.32 cm) of precipitation at elevations above 457.2 meters (1,500 feet) would fulfill the entire annual groundwater budget for this basin.

2.6 Demography and Land Use

Approximately 65 adults and children are currently living on Adak. The Adak population increases due to temporary on-island employment, mostly because of ongoing Navy remediation efforts, seasonal fishing and hunting operations, and operation of the fish plant.

The developed downtown area of Adak includes the airfield, port facilities, and light industrial, administrative, commercial/recreational, and residential areas, which are currently owned and managed by TAC, City of Adak, and ADOT. USFWS manages the southern portion (117,265 acres) of the island, which is within the AMNWR.

All residences and commercial activities are located in the city of Adak. Access to the Parcel 4 OU B-2 area is restricted via locked gates, fences, and posted signs. The anticipated future land uses for Parcel 4, when transferred, are expected to be wildlife management, subsistence (fishing and hunting), research, and recreation.

2.7 Ecology

The following text describes the vegetation, fish, wildlife, and threatened or endangered species on Adak Island.

2.7.1 Vegetation

The native vegetation of Adak Island is that of a terrestrial-maritime tundra ecosystem. The acreage within OU B-2 primarily consists of undeveloped land or land formerly used for military training exercises. Undeveloped areas within the project site boundaries are sedge-dominated (*Carex* spp.) tundra typically found in the Aleutians. The creek beds are covered by sedge-dominated plants intermixed with wet area plants such as red fescue (*Festuca rubra)* and hairgrass (*Deschampsia beringensis)*. There are essentially no trees of value to wildlife in either the developed or undeveloped areas.

Adak Island is lushly vegetated from sea level to about 305 meters (1,000 feet) in elevation. Upland vegetation varies with environmental factors, including the presence of wetlands, altitude, presence or absence of seasonal snowpack, and shelter from wind. Wetland vegetation consists of hydrophilic sedges, rushes, willows (small shrub types), horsetails, buttercups, ferns, and butterworts. Upland meadows that are not classified as wetlands can support a wide variety of vegetation including crowberry, sedges, mosses, lichens, various grasses, willows (shrub types), monkshood, lupines, buttercups, anemone, and cow parsnip. Lakes are generally lacking in vegetation, but the vegetation, when present, includes algae. Streams support algae, buttercups, *Streptopus* sp., and umbels. Vegetation in seeps can be very dense. Rocky shores support rockweed and kelp (USFWS, 1995a).

2.7.2 Fish and Wildlife

Because of Adak Island's harsh climate conditions and relative lack of vegetative structure, the diversity of wildlife inhabiting the island is fairly low. However, several species together characterize the wildlife assembly found in and around Adak. Wildlife typically found around developed areas includes two open-field bird species, the snow bunting and Lapland longspur. Song sparrows and tundra voles are the major inhabitants of the dense vegetation lining creek beds, and ptarmigan inhabit the hillside areas near Mt. Moffett. The beach fringes at the mouths of the major creeks provide foraging opportunities for several species of birds, including the bald eagle, common raven, several species of gulls, rock sandpiper, gray-crowned rosy finch, and winter wren.

Marine mammals found in the bays and harbors of Adak Island, both year-round and on a migratory basis, include the harbor seal, orca, northern harbor porpoise, Dall's porpoise, sperm whale, Baird's beaked whale, goosebeaked whale, gray whale, minke whale, fin whale, humpback whale, right whale, sea otter, and Steller sea lion.

USFWS reports that three streams on the west side of Andrew Lake, including Moffett Creek, support several species of anadromous fish. These are the only sensitive ecological receptors identified by USFWS that are located within OU B-2. Five different fish species were identified in Andrew Lake and the streams entering the lake during surveys in 1993 and 1994. These species are Dolly Varden, residual Coho salmon, kokanee, threespine stickleback, and coast range sculpin. Dolly Varden, coast range sculpin, sockeye salmon (anadromous and lacustrine forms), pink salmon, and Coho salmon were observed in streams entering the lake. Anadromous fish access to this watershed is restricted during some years by debris that accumulates in the Andrew Lake spillway connecting the lake to Andrew Bay (USFWS, 1995b).

2.7.3 Threatened, Endangered, and Sensitive Species

The Aleutian Canada goose does not nest on Adak Island but occasionally stops there. The Aleutian Canada goose was recently de-listed from the list of threatened and endangered species; however, USFWS will monitor this species for a period of at least 5 years after the de-listing. The federally endangered short-tailed albatross may be found offshore of Adak occasionally, but it is unlikely to be found in nearshore waters.

The Steller sea lion is now listed as endangered. This marine mammal's habitat includes ocean areas, rookeries, and haulouts. The known rookery and haulout on Adak Island are near Cape Yakak on the island's southwest side within AMNWR-designated land.

The northern sea otter is listed as threatened. This marine mammal's habitat includes the nearshore waters and shallow bays along the coast of the Aleutian Islands and Alaskan Peninsula. On Adak, northern sea otters can be found in Clam Lagoon and in the surrounding nearshore shallow waters and kelp beds. Clam Lagoon is located southeast of Andrew Lake and is outside the boundaries of OU B-2.

The Aleutian shield fern, an endangered plant, has its sole habitat on Mt. Reed, where fewer than 130 plants exist (Boone, 1995). Mt. Reed is southwest of downtown Adak and is outside the boundaries of OU B-2.

SECTION 3

Previous Investigations

Numerous environmental studies have been conducted on Adak Island over the past 20 years, including several PSEs and an RI/FS for OU A, which encompassed the military reservation with respect to non-ordnance-related chemical contamination. Findings from these previous investigations that are relevant to completion of the OU B-2 RI/FS are summarized in the following sections.

3.1 Initial Assessments and Preliminary Site Evaluations

As indicated in Section 1.2.2, the 1986 IAS identified 32 sites at Adak that were potentially contaminated with hazardous substances such as chlorinated solvents, batteries, and transformer oils containing PCBs. These sites included landfills, storage areas, drum disposal areas, spill sites, and pits for waste oil and firefighting training (NEESA, 1986). The contamination at these sites potentially posed a threat to the sensitive environments both on and off the island, and possibly to Adak residents (EPA, 1992).

From 1993 through 1996, four rounds or batches of PSEs were conducted. The PSE process included a risk-based screening evaluation of human health and ecological risk using results for soil, surface water, and sediment samples collected at the PSE sites. Sites identified by this process as requiring additional evaluation were included in the base-wide RI/FS performed by URS. Field work for the base-wide RI/FS began in spring and was completed in summer 1996. The final RI/FS report was published in September 1997 (URS, 1997).

Conditions in three areas in the OU B-2 area were evaluated in the PSEs, resulting in the following recommendations:

- **SWMU 1 – Range Complex at Andrew Lake (inclusive of OB/OD-01 and nearby AOCs, Moffett Creek, and Andrew Lake)**
  - Restrict site access because of the presence of UXO, conduct a UXO survey, and evaluate remedial alternatives, including institutional controls.
  - Remove leaking petroleum drums and affected soil, collect confirmation samples, and complete risk evaluation/FS to address risk associated with petroleum contamination.
- **SWMU 8 – Andrew Bay Seawall (inclusive of ALSW-01, BC-03, and portion of ALDA-01)**
  - Restrict site access because of the presence of UXO, conduct a UXO survey, and evaluate remedial alternatives, including institutional controls.
- **SA93 – WWII suspected mortar impact area (inclusive of SA93-01 through SA93-04)**
  - Conduct a UXO survey and evaluate remedial alternatives, including institutional controls.

3.2 1996 Navy Unexploded Ordnance Survey

In 1996, the Explosive Ordnance Disposal (EOD) Mobile Unit Eleven Detachment Northwest, stationed at Naval Air Station (NAS) Whidbey Island, Washington, conducted an ordnance survey in the known range areas of Adak as part of the OU A RI/FS. The areas surveyed were as follows:

- SWMU 1 – Range Complex at Andrew Lake
- SWMU 2 – Minefield Area at Clam Lagoon (suspected minefield)
- SWMU 8 – Andrew Bay Seawall
- SA93 suspected mortar impact area
- Inhabited areas (downtown Adak area)

SWMU 1, SWMU 8, and SA93 lie within OU B-2, so the evaluation of these areas produced data that were relevant to follow-on MEC studies and the OU B-2 RI. These three areas were either intrusively investigated or visually inspected to determine the potential for ordnance contamination.

In most areas, a 10-ft-wide survey path was swept with a hand-held magnetometer to identify subsurface metallic anomalies. The anomalies were then excavated and removed in order to determine their nature. In SA93, which was suspected to be contaminated at a higher density, a center hub was selected and eight 10-ft-wide radial pathways were swept. In SWMU 8, the beach area was visually inspected for ordnance that may have washed up during storms. RG-01 in SWMU 1 was visually evaluated, but it was deemed too dangerous for the EOD personnel to enter. After this investigation, the Detachment Northwest Officer in Charge prepared recommendations for each of these areas regarding future clearance activities and land use restrictions.

In the areas intrusively investigated, the nature and depth of each target were recorded. Coordinates were also assigned so that target locations could be reacquired at a later date. Field observations regarding ordnance-related features (such as detonation craters) were documented in the report (Navy, 1996).

3.3 1997 OU A RI/FS

The OU A RI/FS report published in 1997 first identified the potential for ordnance-related contamination on Adak Island. As part of the RI/FS, data collected at sites during the PSEs—including four UXO sites, several suspected chemical warfare materiel (CWM) areas, and three water bodies—were evaluated. Evaluations conducted during the RI/FS determined potential risk to support identification of the need for remedial action, further study, or NOFA. Document reviews and site surveys were conducted for UXO sites and suspected CWM areas to determine whether UXO or evidence of chemical warfare agents was present. Chemical constituents found at the sites were screened against risk-based screening concentrations (RBSCs) for that chemical.

Conditions at SWMU 1 were evaluated during the OU A RI/FS. SWMU 1 was located in the Moffett Creek alluvial plain west of Andrew Lake, and is now within the Range Complex at the Andrew Lake portion of OU B-2 (Figure 2-1). During its active use, this area was divided into OB/OD areas and live firing ranges, as well as storage and support areas. Many of these areas are now AOCs in OU B-2. Several environmental samples were collected in this area during the PSEs, including ten surface soil samples from the OB/OD area, as well as seven sediment and three surface water samples from Moffett Creek and Andrew Lake, as further described below.

3.3.1 Soil Sample Results

Ten surface (0 to 1 feet bgs) soil samples were collected within the 600-ft-diameter OB/OD area and analyzed for MCs, inorganics, total petroleum hydrocarbons (TPH), and total cyanide. Four of the samples were taken from the area near a burn pan present at the time of sampling (expected to be the most affected area). Those four samples were also analyzed for volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). Results from the OB/OD area sampling indicated trace concentrations of MCs, inorganics, TPH, VOCs, and SVOCs. A screening-level risk assessment was performed in which detected constituents were compared with the available EPA Region 10 human health RBSCs, Adak ecological RBSCs, and Adak background concentrations. The following chemicals exceeded these screening levels and, therefore, were identified as chemicals of potential concern (COPCs) in surface soil:

- Four MCs (2,4-dinitrotoluene, 2,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, and cyclotrimethylenetrinitramine [RDX])
- Three inorganics (copper, lead, and zinc)
- Three SVOCs (benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, and indeno[1,2,3-cd]pyrene)

Virtually all of the exceedances (with the exception of metals at two locations) occurred at four sampling locations in the approximate center of the OB/OD area near the burn pans, where the greatest chemical impact would be expected. A subsequent, more detailed risk assessment was conducted that used the analytical results from samples near the burn pans. The results of that risk assessment indicated that, for human health, site soils did not pose a significant risk to hypothetical residential, recreational, and occupational use, and for ecological health, a small area beneath the burn pan was problematic. The burn pan associated with these samples has since been removed.

3.3.2 Sediment and Surface Water Sample Results

Sediment and surface water samples were collected from water bodies in and near SWMU 1 during the PSEs. These samples were collected in the vicinity of Moffett Creek and analyzed for a suite of chemicals, including inorganics, VOCs, SVOCs, MCs, PCBs, pesticides, and total cyanide. Samples from Moffett Creek and Andrew Lake contained trace amounts of inorganics, VOCs, SVOCs, and one MC (4-amino-2,6-dinitrotoluene) in sediment, and trace amounts of inorganics, VOCs, and SVOCs in surface water. A screening-level risk assessment was performed in which the results were compared with the respective EPA Region 10 human health RBSCs, Adak ecological RBSCs, and Adak background concentrations. No exceedances of these benchmarks were identified, and no COPCs relative to either human health or ecological impacts were identified.

3.4 1997 Historical Archive Search

In 1997, the Navy began performing a detailed search of historical archives for relevant information about ordnance activities and areas on Adak. This effort, completed in 1998, involved comprehensive research of historical records at more than 20 locations. Interviews were also conducted with military veterans formerly stationed on Adak. During the archive search, more than 1,000 records were reviewed, ranked, and placed in a master archive file. These records included documents (firing orders, defensive plans, ammunition inventories, etc.), maps, photographs, and transcripts of personal interviews that were relevant to MEC storage, use, or disposal on Adak. The information gathered during the archive research was later used with the field data from the 1999 SI (see Section 3.6) to identify the initial 184 areas of potential concern on Adak. The results of the archive search are documented in the Archive Search Report (Foster Wheeler Environmental, 1998).

3.5 1998 Minefield Investigation

In 1998, the Navy initiated the investigation of 23 potential defensive minefield locations on Adak. Although records indicated that the fields were not to be emplaced unless invasion of the island was imminent, it was deemed prudent to evaluate the identified areas. Three of the potential minefield sites were located in what is now OU B-2 on either end of the portion of the seawall bordering Andrew Lake on the north. Specific investigation patterns were developed that were designed to detect both hasty and deliberate minefields. No evidence of these defensive minefields was found, and it is anticipated that they were never emplaced because there was no imminent danger of invasion. The results of this investigation are documented in the Minefield Summary Report (incorporated in Foster Wheeler Environmental, 1998).

3.6 1999 Site Investigation

The 1999 SI included the outback (outlying) areas of Adak and was intended to provide ordnance contamination data to support decisions on the ability to reuse Adak Island. This investigation was focused on the areas north of the military reservation boundary, excluding the downtown area that had been previously investigated. Many of the AOCs currently in OU B-2 were investigated during this study as part of larger sectors.

Twenty-six investigation sectors were developed for the SI based on geographic homogeneity, past use, and anticipated ordnance density. These sectors generally included large areas that were later divided into multiple AOCs based on the investigation results. Table 3-1 summarizes the OU B-2 AOCs partially or fully included in 1999 investigation sectors (see Figure 3-1). Sectors partially or wholly outside of OU B-2 are not included in the table.

TABLE 3-1
Summary of AOCs Contained in 1999 Investigation Sectors

Sector Name	General Location	AOCs in (or partially in) the Sector	Comments
Andrew Lake	Areas at the NW corner of Andrew Lake, including the Seawall	ALDA-01, ALDA-02, ALSW-01	MAG-01 is most closely related to this sector, but it does not lie within this sector or any other investigated in 1999. MAG-01 was not investigated in 1999
Combat Range #1	Upland areas along the northern coast of Adak west of Andrew Lake	C1-01	Most of Combat Range #1 is outside of OU B-2
Hand Grenade Range	Near the center of the Range Complex at Andrew Lake west of the lake	HG-01	Now HG-01
Mortar Impact Area	Upper valley in the Range Complex at Andrew Lake, west of the OB/OD area	MI-01, MI-02, MI-03, and portions of RR-01 and RR-02	Two east-west trending valleys separated by a steep, rocky ridge
OB/OD Disposal Range	Circular site near the center of the Range Complex at Andrew Lake	OB/OD-01	Now OB/OD
Range Remainder	Eastern portion of the Range Complex at Andrew Lake minus areas designated as small stand-alone sectors	RR-03, RR-04, and portions of RR-01 and RR-02	Does not include area of HG-01, RG-01, or the Small Arms Range Sector
Rifle Grenade Range	Range Complex at Andrew Lake	RG-01	Now RG-01
SA93 WWII Mortar Impact Area	Plateau east of Andrew Lake	SA93-01, SA93-02, SA93-03, and SA93-04	Cliff on the west descends to MAG-01 area
Small Arms Range	Former rifle range in the Range Complex at Andrew Lake	A portion of RR-02	Now part of RR-02

Each sector in the SI was analyzed to identify hazardous terrain and areas steeper than 30 degrees, which were excluded from the investigation. (The degree of slope determined to be inaccessible was based on the effort required of a reasonably fit person during a hike or other outdoor activity.) The effort level selected was field-evaluated by geophysical crews during the investigation.

Each sector was statistically evaluated for representativeness to determine the amount of sampling (percent of area) required. This area was then divided into 1-meter-wide transects with distances that were equivalent to land area of the statistical model. The transects were randomly distributed within the sector. Transects were geophysically mapped and the data were processed to develop geophysical anomaly maps and target anomaly lists. Target anomalies were chosen for intrusive investigation using statistical protocols for selected areas. Selected target anomalies were excavated to a maximum depth of 3.22 meters (4 feet) in order to identify the target.

The complete investigation results for each sector are provided in *Draft Site Investigation Report* (Foster Wheeler Environmental, 2000a). Ordnance-related findings for the 1999 field season for sectors within or partially within OU B-2 are summarized in Table 3-2.

TABLE 3-2
1999 SI Ordnance-related Target Anomaly Summary

Sector	Target Anomalies Detected[a]	Anomalies Investigated[a]	Ordnance-Related Items[b]	UXO	DMM	MPPEH	Inert Ordnance
Andrew Lake Disposal Site	65	39	27	0	3	24	0
Combat Range #1	125	113	48	3	0	45	0
Hand Grenade Range	180	155	27	2	1	24	0
Mortar Impact Area	522	303	181	16	5	160	0
OB/OD Disposal Range	892	341	104	1	11	92	0
Range Remainder	222	198	52	3	2	47	0
SA93 WWII Mortar Impact Area	342	313	129	26	0	103	0
Small Arms Range	563	359	106	1	6	99	0
Totals	**2911**	**1821**	**674**	**52**	**28**	**594**	**0**

[a]The differences between the values in columns 2 and 3 of this table are due to the presence of non-munitions-related metallic items, such as nails or cans, or false positive target identification stemming from conservative interpretation of raw geographical data.
[b]Ordnance-related items include the total of UXO, DMM, and inert ordnance.

Notes:

DMM = discarded military munitions
UXO = unexploded ordnance

3.7 Preliminary Assessment (AOPC Evaluation) of OU B

After the 1999 SI, the Navy and regulatory agencies agreed to (and developed) a CERCLA-like process for MEC assessment and remediation on Adak as part of a dispute resolution. It was acknowledged that the equivalent of a very detailed site inspection had already been conducted in the form of the 1999 SI, and that by incorporating the SI data into a preliminary assessment, the initial requirements of the CERCLA process for a PA/SI could be fulfilled without performing additional site inspection.

The PA was performed to identify the AOPCs that required further evaluation or action (Foster Wheeler Environmental, 2000b). The first step in this process was the development of an MEC conceptual site model (CSM) for Adak. This CSM was developed based on a review of the existing data, release and physical transport processes, and potential human and ecological receptors associated with OU B.

The CSM was intended to encompass all historical ordnance uses on OU B and the expected exposure pathways associated with those uses. In the CSM, the AOCs are the primary sources of contamination, but they differ by the way they were used (impact areas, storage areas, OB/OD areas, etc.). These are the AOC types referred to throughout this document. The CSM is presented and discussed in more detail in Section 4.1 of this report.

3.7.1 AOPC Assessment (Level 1 Screen)

The Project Team developed an AOPC assessment approach (the Level 1 Screen) that built on four screening criteria to categorize an AOPC:

- Likelihood of UXO contamination
- Density of UXO contamination
- Ordnance hazard severity
- Strength of archival and field evidence

The Project Team developed the framework, the interrelationship among the criteria, and the factors relevant to each criterion. Phase 1 of the Level 1 screening process integrated a qualitative evaluation of the assumed or demonstrated likelihood, density, and potential severity of MEC contamination. An analysis of the relative strength of evidence supporting those assumptions was made to determine whether or not each AOPC represented a sufficiently significant hazard to warrant consideration of further action. Further actions included additional investigations, evaluation in the FS, and immediate actions. Those sites that were rated as not posing an unacceptable ordnance-related hazard, as supported by an acceptable level of evidence, were judged to be appropriate for NOFA and were eliminated from additional screening or consideration for further action.

Sites having a low likelihood and density of contamination, and that were known or suspected to contain relatively low-hazard ordnance, were screened as NOFA if the assumed CSM was supported by acceptably strong data. Those sites not screened as NOFA were advanced to Phase 2 of the Level 1 screening process, where the need for further action (such as investigation or remediation) was evaluated. These included sites known or suspected to have low quantities of low-hazard ordnance, but not having an acceptable strength of data to support the assumed CSM. Some level of additional data collection or visual observation was needed in order to complete the hazard screening for these sites. The non-NOFA sites also included sites known or suspected to have higher quantities of ordnance or higher hazard ordnance. These sites were prioritized for further action (either investigation or cleanup), and a determination of the most appropriate form of action was made.

Phase 2 of the screening process evaluated AOPCs with respect to the ease of access for assessment, and exposure to ordnance. Sites with very limited access not only would be very difficult to assess, but also they would not pose the same level of hazard as an accessible site containing the same type and quantity of ordnance. Sites with lower accessibility were judged to have a lower priority for action than those freely accessible to the public.

After this phase of screening, AOPCs having a sufficiently high ranking for further action were evaluated to determine the most appropriate level of activities. This determination was based on the perceived qualitative risk for the AOPC (ordnance hazard ranking) and the relative access for public exposure. These sites became AOCs and were evaluated by using the criteria in the Level 2 Ordnance and Explosives Sampling Methodology for selection of appropriate assessment and/or analysis methodologies for that type of site. Development and application of the Level 2 Ordnance and Explosives Sampling Methodology to the 2008 RI planning process are presented in Section 4.1 of this report.

3.7.2 PA Outcomes for OU B-2 Sites

After Phase 2 of the OU B screening process, 183 AOPCs were selected for PA screening. Of this number, 78 were found to meet the requirements for NOFA based on historical and physical evidence indicating that the site posed little or no qualitative risk to humans. Twenty-six AOPCs were selected for site inspection because of a lack of evidence with which to assess potential risk. Seventy-seven of the AOPCs screened were referred for RI based on the nature and strength of available field data and/or the documented historical land use. These AOPCs included most of the impact areas on Adak, as well as the range areas at Andrew Lake and most of the sites where ordnance was found during the 1999 SI. One site (RG-01) was advanced directly to the FS stage based on previous remediation or special circumstances that prevented investigation.

Most of the 183 sites discussed above are OU B-1 sites that have already been remediated and/or approved for NOFA. As such, the Level 1 screening outcome for these sites is not relevant to this RI. The results of the Level 1 screening process for the remaining OU B-2 sites are summarized in Table 3-3. Two OU B-2 sites (LJ-02A and JM-01), which were both defined after the PA was completed, have also been included in the table for completeness.

TABLE 3-3
Summary of Level 1 Screening Results for OU B-2 Sites

		Level 1 Screening Results*				Status After PA				
Candidate Area	**Type of AOC Used for PA Screening**	**Likelihood of Contamination**	**Density of Contamination**	**Ordnance Hazard Category**	**Strength of Evidence**	**NOFA**	**RI**	**Inspection or Sampling**	**FS**	**Comments**
Andrew Lake Disposal Area										
ALDA-01	OB/OD Disposal Area	High	High	Critical	Strong		✓			Screened as OB/OD disposal area based on the presence of craters even though historical data suggest potential for burial here.
ALDA-02	Bombing Range	High	High	Critical	Average		✓			Changed to NOFA by Project Team agreement.
Andrew Lake Seawall										
ALSW-01	Large-Scale Burial	High	High	Marginal	Weak			✓		Defaulted to burial site for screening because the source ordnance was dumped offshore. Current evidence of limited disposal by burial west of the seawall spillway.
Blind Cove Impact Area										
BC-03	Firing Point	Medium	Low	Marginal	Weak			✓		Investigation complete; approved for NOFA.
Combat Range #1										
C1-01	Combat Range	Low	Low	Critical	Average		✓			Upgraded to target/impact area. Investigation complete; sediment sampling proposed.
Andrew Lake Hand Grenade Range										
HG-01	Target/Impact Area	High	High	Catastrophic	Average		✓			
Jessie Morgan CWM Disposal Site										
JM-01	--	--	--	--	--	--	--	--	--	Identified after PA; not located after diligent effort; approved for NOFA.
Lake Jean Ammunition Storage Area										
LJ-02A	--	--	--	--	--	--	--	--	--	Identified after PA; RI complete; approved for NOFA.

TABLE 3-3
Summary of Level 1 Screening Results for OU B-2 Sites

		Level 1 Screening Results*				Status After PA				
Candidate Area	**Type of AOC Used for PA Screening**	**Likelihood of Contamination**	**Density of Contamination**	**Ordnance Hazard Category**	**Strength of Evidence**	**NOFA**	**RI**	**Inspection or Sampling**	**FS**	**Comments**
WWII Magazine at Andrew Lake										
MAG-01	Storage Area	Low	Low	Marginal	Weak		✓			No investigation to date; located in proximity to several WWII gun emplacements and pistol and rifle range.
Andrew Lake Mortar Impact Area										
MI-01	Target/Impact Area	High	High	Critical	Average		✓			Now known to contain abandoned ordnance as well as fired ordnance.
MI-02	Target/Impact Area	High	High	Critical	Average		✓			
MI-03	Target/Impact Area	High	High	Critical	Very Strong		✓			Southern sector may contain “kick-outs” from OB/OD based on the 1999 SI.
Mt. Moffett Lone 81 mm Mortar										
MM-10D	Target/Impact Area	High	High	Critical	Very Strong		✓			RI complete; approved for NOFA.
Andrew Lake OB/OD Disposal Range										
OB/OD-01	OB/OD Disposal Area	High	High	Critical	Very Strong		✓			
Andrew Lake Rifle Grenade Range										
RG-01	Target/Impact Area	High	High	Catastrophic	Weak				✓	Too hazardous for assessment. NTCRA completed in 2008.

TABLE 3-3
Summary of Level 1 Screening Results for OU B-2 Sites

		Level 1 Screening Results*				Status After PA				
Candidate Area	**Type of AOC Used for PA Screening**	**Likelihood of Contamination**	**Density of Contamination**	**Ordnance Hazard Category**	**Strength of Evidence**	**NOFA**	**RI**	**Inspection or Sampling**	**FS**	**Comments**
Andrew Lake Range Remainder										
RR-01	Storage Area	Low	Low	Catastrophic	Average		✓			Defaulted to storage because this was closest to use as a range buffer.
RR-02	Storage Area	Low	Low	Critical	Average		✓			Defaulted to storage because this was closest to use as a range buffer.
RR-03	Storage Area	Low	Low	Marginal	Average		✓			Defaulted to storage because this was closest to use as a range buffer.
RR-04	Storage Area	Low	Low	None	Very Strong	✓				Defaulted to storage because this was closest to use as a range buffer; originally NOFA; transferred to RI in 2007.
Andrew Lake Subcaliber Training Range										
SA-01	Firing Point	Medium	Low	Negligible	Weak			✓		
Source Area-93										
SA93-01	Target/Impact Area	High	High	Critical	Very Strong		✓			
SA93-02	Target/Impact Area	High	High	Critical	Average		✓			Screened as target area during PA based on proximity to Impact Area. Reclassified as storage area for reconnaissance in current RI.
SA93-03	Firing Point	Medium	Low	Critical	Average		✓			Reclassified as target/impact area.
SA93-04	Target/Impact Area	High	High	Critical	Average		✓			Screened as target area during PA based on proximity to Impact Area. Reclassified as storage area for reconnaissance in current RI.

*Criteria used in the Level 1 Screen are described in Preliminary Assessment Report (Foster Wheeler Environmental, 2000b).

3.8 2000 Offshore Environmental Survey of the Andrew Lake Seawall

On August 5, 2000, EOD Mobile Unit 11 conducted an underwater survey in the waters directly offshore of the Andrew Lake seawall. Through the use of surface swimmers, the EOD objectives were to verify the presence and extent of MEC and to determine whether the underwater environment was suitable for the safe conduct of diving operations, should further reconnaissance be required. The swimmers were deployed seaward of the surf zone in water that was approximately 6.1 meters (20 feet) deep at a location 200 meters (656 feet) west of the Andrew Lake spillway. They swam east along the seawall to a location approximately 300 meters (984 feet) east of the spillway. More than 20 MEC items were located during the survey. These items were projectiles and mortars that ranged between 40 millimeters (mm) and 81 mm in size. Because of poor visibility, some items may have gone undetected. The survey found that underwater conditions were conducive to diving operations in moderate weather conditions; however, substantial bottom surge may occur in shallower water during periods of sea swells and wave action (EOD, 2000). This study indicated that wash-up of MEC found on the Andrew Lake seawall could be coming from an extensive offshore debris field, and it further described the seabed in this area as an “ordnance rich environment.”

3.9 2000 OU B-1 RI/FS

The purpose of the OU B-1 RI/FS was to collect and analyze data at sites potentially contaminated with MEC in selected locations of OU B at the former Adak Naval Complex. Specifically, sites were selected that were intended for inclusion in the transfer of more than 43,000 acres to TAC for civilian reuse. These sites were placed in a subgroup called OU B-1. The remaining AOCs were segregated into a second subgroup (OU B-2) for future evaluation and potential transfer. The data collected during this investigation, and from previous investigations, were used to provide input to an Adak-specific ESHA designed by the Project Team (OU B Project Team—Hazardous Assessment Working Group, 2000). The Adak-specific ESHA tool analyzes the results of the MEC portion of the RI and determines the potential magnitude of the risk/hazard present. The ESHA methodology for Adak was developed as part of the overall framework for assessing and managing potential threats due to the presence of MEC on Adak Island. The methodology reflects the following premises about ordnance risk or hazard on Adak:

- Areas where MEC are known or indicated to be present create more potential for explosive hazards than areas where MEC have been purposefully searched for and have not been found or where all known ordnance has been removed.
- Different types of ordnance present different potentials to detonate if disturbed, and, if detonated, can produce a range of adverse consequences.
- The potential for explosive hazards is created when ordnance are located where they are likely to be disturbed by current and/or future land use activities.
- There is greater potential for explosive risk where public exposure is greatest (e.g., increased contact or easier accessibility).

The factor and subfactor inputs to the Adak ESHA methodology are both quantitative and qualitative, with the overall framework and ESHA scoring being qualitative in nature. The ESHA assigns relative scores to qualitative estimates of the MEC but does not define quantitative measures of known MEC risk. Although five separate hazard scores ranging from a low of A to a high of E are possible, there are only two possible management options: (1) Adak NOFA with baseline institutional controls (e.g., educational awareness), or (2) evaluate in the FS.

During preparation of the OU B-1 RI/FS Report (Foster Wheeler Environmental, 2001), the ESHA process was conducted on 44 individual sites located within 41 AOCs. The majority of the sites screened in the ESHA received either an A score (38 sites) or a B score (three sites). These two scores reflect the lowest levels of explosives hazard, which resulted in a recommendation for NOFA for 41 of the 44 sites. Two sites received a score of C and one site received a score of D in the ESHA, reflecting higher levels of hazard and indicating that remedial action of some type may be needed to reduce risk to the public. None of the 44 sites screened received an E score, which represents the greatest level of relative explosives hazard. Two sites that received an A score were earmarked for additional fieldwork by the Project Team based on specific conditions or requirements. Seven sites were also identified for chemical sampling for MC. ESHA methodology is described in Section 7 of this report.

3.10 2001 Frost Heave Study

During the 2000–2001 frost heave study, temperature, moisture, and surrogate ordnance displacement were measured at four sites on Adak to determine the influence of frost heave on buried surrogate munitions. Soil temperatures at the higher elevation test sites reached a low of -10°C during the study; however, the soil in the test areas did not freeze deeper than 8 in. (20.3 cm) bgs. Measurements before and after the winter season on Adak showed no trend of movement due to frost heave action on buried surrogate munitions. Test data indicated that 2000–2001 winter temperatures were typical of those recorded during the past 50 years.

The study evaluated frost heave movement at elevations from 13.7 to 269 meters (45 to 883 feet) above mean sea level. Movement of most surrogate items buried from 7.6 to 30.5 cm (3 to 12 in.) bgs was less than 0.31 cm (±0.12 in.), with a measurement error of 0.1 cm (±0.04 in.). Extrapolation of the data indicates that some frost heave action would be expected at higher and colder elevations. On the basis of the observed data during this “typical” winter at the highest elevation site (Nurses Creek), the estimated time for ordnance buried at 30.5 cm (12 in.) to reach the surface could be 100 years.

The study concluded that most of the land area below 304.8 meters (1,000 feet) in elevation on Adak does not experience significant frost heave. Areas between 304.8 meters (1,000 feet) and 457.2 meters (1,500 feet) in elevation may experience temperatures low enough to cause some frost heave in the upper 20.32 to 25.4 cm (8 to 10 in.) of the soil, if sufficient soil is present. At elevations above 457.2 meters (1,500 feet), there is generally not enough soil for frost heave to occur.

3.11 2001 MEC Remedial Actions in OU B

In 2001, assessment and remedial actions for UXO-related contamination were conducted in 19 AOCs, including two AOCs under consideration in the OU B-2 FS. These two sites (C1-01 and RR-03) were sampled at three locations to determine whether ordnance-related chemicals were present in the soil. The sites were selected for sampling based on the discovery of munitions that were breached, allowing the filler to contact the soil immediately surrounding the items. The soil samples collected in these two AOCs were analyzed for 14 ordnance-related constituents, but no detectable levels of the chemicals were found.

3.12 CWM and Radiological Investigations in OU B

Historical records indicate that CWM was managed on Adak, but extensive research and on-island field investigations have been conducted and no evidence of CWM or residuals has been discovered to date.

In 2002, assessment and remedial actions for UXO-related contamination were conducted in 11 AOCs, including 1 potentially new AOC considered for inclusion in the OU B-2 FS. This site, JM-01, was identified via interviews with a veteran who was stationed on Adak during WWII. The individual, herein referred to as J.M., indicated that 24 large projectiles (105 mm) filled with blister agent were disposed of in a single, earth-tamped (buried at approximately 4.3 meters [14 feet] bgs) detonation in 1944. The objective during the 2002 field season was to locate this AOC, if possible, and conduct assessment activities to confirm or refute the information regarding the disposal operations. Thirteen possible candidate sites were identified based on information provided by J.M. in consideration of the locations of historical roadways in the general vicinity of interest, as well as visible soil disturbance (as noted on aerial photographs). Reconnaissance using a Vallon metal detector was performed at the site originally identified by J.M.; however, no evidence of the historical disposal operation was found. All the sites selected for possible field evaluation were dismissed upon review of available data. The project team agreed to NOFA on this potential AOC until, and unless, more detailed information becomes available.

A radiological survey was conducted on Adak in 1997 by the Radiological Affairs Support Office to identify undocumented radioactive material that may have been disposed of on the island. The survey included a review of the disposal of medical and instrument waste, as well as wastes associated with military operations. The survey did not find any radioactive contamination (URS Greiner, Inc., 1997).

3.13 2002 Andrew Bay Sediment Dynamics Study

In 2002, the Navy commissioned a mobility analysis by the Woods Hole Group for the Andrew Bay offshore area in an effort to gain further understanding of the MEC transport processes at work in the shoreline area and to provide data for the FS. Data reviewed for the study included historical data from EOD beach sweeps; bathymetry; sediment characteristics; wave, current, and tide information; and the EOD dive survey that was conducted in August 2000.

The objective of the mobility analysis was to determine when and where the types of MEC (usually DMM) typically found in Andrew Bay would most likely mobilize and in which direction they were likely to move. Three different types of MEC were selected for the modeling analysis. The lightweight 60 mm mortar round was selected for its relative ease of potential migration, the 81 mm mortar round was selected as a median mobility case for MEC in the Andrew Bay region, and the 75 mm high explosive (HE) round was chosen to because of its low potential for mobility. These three rounds represented the range of mobility characteristics for the typical MEC found in Andrew Bay along the seawall.

The wave environment in the region was determined to be the dominant physical process governing MEC migration in Andrew Bay. From the wave analysis, four main cases were chosen for modeling, specifically:

1. Average Significant Wave Height and Peak Period
2. Maximum Wave Height and Peak Period
3. November Average Wave Height and Peak Period
4. July Average Wave Height and Peak Period

These cases represented the average, maximum, winter, and summer conditions in Andrew Bay. During these wave conditions, probabilities for MEC migration were modeled for the three MEC types mentioned above. The resulting maps of MEC migration probabilities allowed for an assessment of the MEC migration risk throughout Andrew Bay during typical and extreme wave conditions.

Some general conclusions were drawn from this analysis effort:

- MEC mobility is highest in the zone where waves break. The wave model clearly identified the extent of the breaking zones for different wave conditions.
- There is a persistent wave shoaling in the central bay that is potentially responsible for a significant amount of the MEC found on the beach.
- The orientation of the central shoaling region changes with wave direction, but mobility probabilities vary little with wave direction.
- The identification of the central shoal and other areas of MEC mobility can be used to refine potential remediation alternative analysis efforts in the region.
- The central shoal area is quite large and may significantly affect the implementation of a successful MEC remedial option in Andrew Bay.
- Because the offshore extent of breaking zones changes with wave height, it is likely that combinations of wave conditions act to slowly migrate larger MEC items to the beach.

This study is presently being updated by University of California, under the direction of Dr. Scott Jenkins.

3.14 2004 MEC Remedial Actions in OU B

In 2002, assessment and remedial actions for UXO-related contamination were conducted in 17 AOCs, including one AOC considered for inclusion in the OU B-2 FS (AOC LJ-02A, which was identified in 2002 as a possible location for JM-01). Previous reports for the general vicinity, such as the J.M. Report (Foster Wheeler Environmental, 2001), stated that items potentially have been buried to depths as great as 4.3 meters (14 feet) bgs. An EM31 ground conductivity meter was used during the 2004 field season with line spacing of 3.5 meters (11.5 feet) at the LJ-02A site. Although no anomalies indicative of trenches were visible in the data, three point source anomalies were identified. A UXO Quality Control (UXOQC) team intrusively investigated these targets on July 26, 2004, but no MEC or other items of concern were found. A complete report of the investigation at AOC LJ-02A can be found in Appendix C of the 2004 After Action Report (ECC, 2006).

On the basis of the data for LJ-02A, NOFA status was recommended for this AOC.

3.15 Non-Time-Critical Removal Action in RG-01

As a result of past military use, the former 40 mm Rifle Grenade Range (RG-01) at Andrew Lake was determined to be a potential safety risk to the public, site personnel, and biological receptors. Historical documentation indicated that seven dud-fired, HE 40 mm grenades were present on the range, as well as one 60 mm mortar and one 81 mm mortar. These items were not removed from the range at the time of discovery because of their hazardous nature. On the basis of this anticipated hazard, the Navy began an NTCRA at this site in 2006.

Field work in 2006 indicated that the historical documentation significantly underestimated the number of MEC items present in RG-01. In 2006, USAE performed the NTCRA on RG-01 and recovered and destroyed a total of 96 live MEC items. Of these, 87 were 40 mm HE grenades. The other nine MEC items were seven live 40 mm riot control tear gas (CS) grenades, a live bomb fuze, and one live cartridge-actuated device (CAD). The live bomb fuze and CAD were most likely “kick-outs” from a nearby demolition range during previous disposal operations. On the basis of the amount of small arms and target debris encountered on the eastern portion of the range, the area was also used extensively for firing of small arms up to and including .50 caliber weapons. During the 2006 field season, one grid was expanded (stepped-out) because of the discovery of MEC near the eastern boundary of the range and the Adak requirement for a 15-m buffer around MEC. Five additional expansion areas were also identified on the eastern boundary, but because of time constraints, the decision was made to delay the investigation of these grids until the next season.

In 2008, USAE performed an analog clearance on the five RG-01 expansion areas identified during the 2006 NTCRA prior to follow-on digital geophysical mapping (DGM) surveys and encountered MEC within the 15-m buffer zone that required an additional analog step-out. A 100 percent DGM survey of accessible areas (slopes < 30 degrees, no obstacles or standing water) at RG-01 was performed after completion of the analog clearance and analog step-outs of grids.

During the DGM clearance, MEC was encountered near boundaries of four grids and it was necessary to perform a step-out of the grids to maintain the 15-m buffer around MEC. The additional step-outs were first analog cleared and then DGM surveyed and cleared. During RG-01 clearance operations, USAE located and disposed of (by detonation) 71 MEC items (seventy 40 mm grenades and one 3.5-inch rocket) and four items of MPPEH (a projectile fuze, a bomb fuze, a 40 mm projectile, and a CAD). On the basis of observations by UXO personnel, the MPPEH items, rocket, and breached munitions were most likely “kick-outs” from the nearby former OB/OD area. Munitions constituent sampling and testing were performed at the locations of the two breached munitions, in accordance with the approved Munitions Constituent Quality Assurance Project Plan (MC QAPP). One of the locations showed RDX levels above project screening level but below action level, so additional sampling was performed at the location (more information about MC sampling at RG-01 in 2008 is provided in Section 5 of this report).

Disposal of MEC/MPPEH was performed by detonation using donor explosives shipped to Adak and stored in the Government’s portable explosives magazine. MPPEH and MD were inspected by UXO technicians, certified by USAE, verified by the Government representative, and then flashed in a thermal flashing unit (TFU) before being sealed in barrels and shipped off the island under proper chain of custody on a barge to a recycling facility for final disposal.

The 2006 and 2008 RG-01 NTCRAs met all requirements of the Action Memorandum and NOSSAINST 8020.15A. The MEC clearance, including the analog and follow-up DGM clearances, meets the remediation requirement of the Action Memorandum (a clearance to 2 feet), and no further clearance should be necessary. However, although the NTCRA cleared RG-01 to the Action Memorandum requirements, the final remedy has not been determined; therefore, the results of this work have been brought forward to the OU B-2 RI/FS for further remedy evaluation (Sections 7 and 8 of this report). The results of site inspections and characterization activities conducted in support of the removal action are presented in an AAR (USAE, 2009).

SECTION 4

Adak CSM, AOC Characteristics, and 2008 RI Data Gaps

This section provides a review of the Adak CSM and Level 2 methodology, summarizes the physical features and known or potential ordnance-related characteristics, and identifies the data gaps that were to be filled at each AOC in OU B-2.

4.1 Adak CSM

The Adak CSM depicted in Figure 4-1 was used to guide a number of assessments, data analysis efforts, and remedial activities that were performed on Adak Island after 2000. Because of those efforts, the AOC type for several of the OU B-2 AOCs is now known to be different from the initial assessment. It was also found that not all AOCs of the same type exhibit the same CSM-related characteristics. Some AOCs, for instance, contain drainage channels that represent potential transport and exposure routes, while other AOCs of the same type do not have drainage channels. The CSM was reevaluated with respect to the specific characteristics of each AOC during preparation of the RI Work Plan. The information from that evaluation was used to create individualized versions of the model that reflect the unique characteristics of each AOC. These models helped guide the development of appropriate RI methodologies for each site. The AOC summaries presented below incorporate the relevant findings of this evaluation.

The primary release mechanisms in each AOC are the actions that resulted in the delivery of ordnance contamination (firing, placement, burial, etc.). The anticipated type of ordnance contamination for each AOC depends on both the AOC type and the types of primary release mechanisms. Secondary sources in the CSM are the media in which the contamination is expected to be located as a result of a release (e.g., soil, surface water, sediments). The model depicts the mode of exposure to secondary sources for potential Adak-specific sensitive receptors (ecological or human) identified in the CSM. (It should be noted that the only sensitive ecological receptor identified by USFWS for OU B-2 is Andrew Lake.)

Surface water and/or groundwater in many of the AOCs contribute hydraulically to Andrew Lake and may act as a transport mechanism for any MEC in the upland areas. A small number of AOCs do not contribute hydraulically to Andrew Lake; however, contaminated soils or sediments in these AOCs are still a potential source of exposure to MEC for transitory human or ecological receptors. The potential for transport of MEC is an important factor in determining the extent of contamination in the various AOCs.

4.2 Summary of Level 2 Methodology

The Level 2 ordnance and explosives sampling methodology was developed by the Project Team and completed in 2000 (OU B Project Team—Hazardous Assessment Working Group, 2000) to guide the development of an effective RI field sampling program for the AOC types in OU B (Table 4-1). The Level 2 methodology is a process that allows collection and analysis of data in a series of logical steps that are designed to accurately bound and characterize AOCs and provide sufficient data for hazard assessment and FS analyses. Many aspects of the Level 2 methodology, including sampling patterns and densities, are tailored specifically to the individualized model developed for each AOC type (see Section 4.3). The various release mechanisms associated with the AOCs are particularly important because the potential distribution of ordnance within an AOC often depends on how that ordnance came to be present in the AOC. In addition, certain release mechanisms are associated with higher hazard MPPEH (i.e., fired items are generally UXO, which is typically more sensitive than DMM to stimulus that could cause it to function).

The CSM for OU B-2 (Figure 4-1) includes a listing of primary release mechanisms for the various AOC types, which were central to the development of appropriate investigation patterns and methods. The primary release mechanisms and their associated AOC types are as follows:

- Firing—Target/Impact Areas, Range Safety Fans, Combat Ranges
- Dropping—Aerial Bombing Ranges and Bomb Jettison Areas
- Placement—Minefields
- Destruction—OB/OD Areas
- Disposal—Large-Scale Burial/Disposal Areas
- Loss/Abandonment—Bivouac Areas, Firing Points, Gun Emplacements, Magazines, Storage Areas, and Transfer Points

The Level 2 methodology included three basic investigation elements: site assessment (referred to as reconnaissance in this report), site inspection, and site characterization. These elements generate different types of data for different needs, including refining the Level 1 screen, delineating inaccessible areas, acquiring data to design field investigations, and characterizing sites to support FS analyses or determine the need for a response action. Many of the investigation tasks specified in the Level 2 methodology were completed for the OU B-2 AOCs prior to the 2008 RI. The work conducted in 2008 is primarily supplemental characterization; however, an understanding of the various Level 2 investigation approaches and their applicability to previous work in the OU B-2 AOCs is needed to understand the rationale for the 2008 RI activities. The following sections briefly describe the Level 2 investigation approaches and the RI field methodologies developed based on the Level 2 specifications.

4.2.1 Site Reconnaissance

Site reconnaissance was envisioned as a necessary activity for all OU B AOCs. The goal of the site reconnaissance, as defined by the Project Team, was to gather data required for the operational planning of field activities to be performed in the subsequent elements—site inspection and site characterization. The accumulation of data during site reconnaissance was intended to:

- Increase the precision of the Level 1 screen
- Delineate inaccessible area boundaries
- Acquire site characteristics data needed to adequately plan the field sampling
- Complete the acquisition of AOC attribute data required for input to the FS

The intended purpose of the reconnaissance procedure was very similar to that for the site assessment described in the Level 2 methodology; however, the Level 2 methodology included an effort to identify or confirm/refute hazard levels in specific portions of the AOCs. The 2000 RI did not include this activity. Decisions regarding potential for ordnance contamination or evaluation of physical features affecting the methodologies developed for site inspection or RI/FS were considered independent of hazard.

4.2.2 Site Inspection

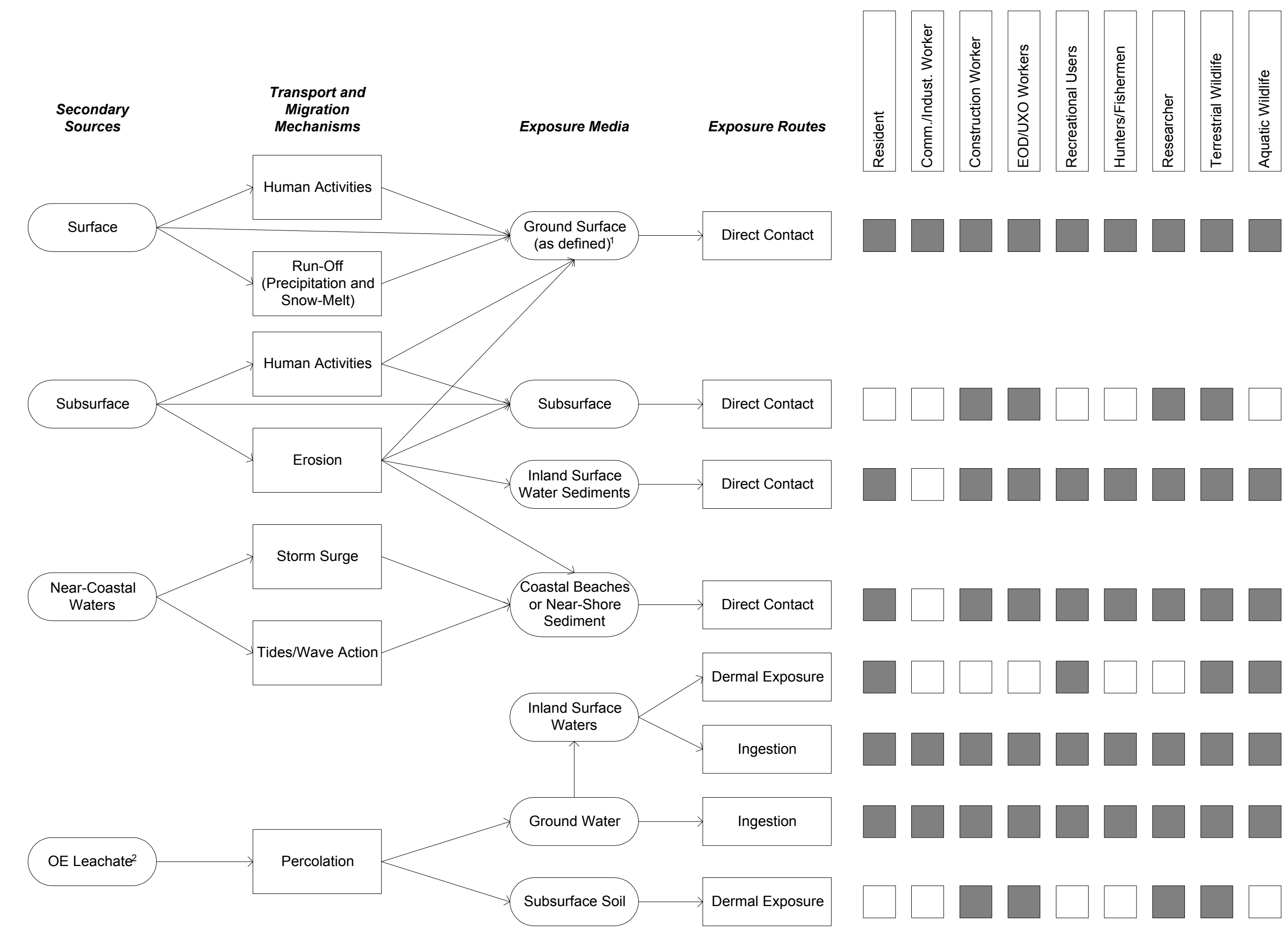
Site inspection was intended to occur in areas where field evidence was not strong enough to complete the Level 1 screen, and in areas in which the CSM predicted contamination resulting from undocumented activities (e.g., abandonment at a firing point or free-fire in a combat range). Inspection involves systematic searches for ordnance contamination, and the goal of the Level 2 methodology site inspection (as defined by the Project Team) was to determine the existence and location of ordnance contamination within an AOC. Key components of the site inspection process are identification of the type of ordnance in an AOC and selection of the detector system to be used for the search. The ordnance identification step is important because it determines the appropriate investigation pattern (transect spacing) for the search (Table 4-2). The final step in site inspection was to evaluate the field data and complete the Level 1 screen for the AOC.

Conceptual Model of Ordnance Release

Ordnance Related Activity	Primary Source (AOPC Type)	Primary Release Mechanism	Expected Ordnance Contamination	Secondary Source[1/]
Ordnance Handling and/or Storage	Transfer Points	Mishandling/Loss	Unfired (fuzed or unfuzed) Ordnance	Surface
	Storage Magazines/ Ammunition Supply Points	Mishandling/Loss	Unfired (fuzed or unfuzed) Ordnance	Surface
		Burial	Unfired (fuzed or unfuzed) Ordnance, possible retrograde	Subsurface Other Constituents
Weapons Training	Firing Point	Mishandling, Loss or Abandonment	Unfired (fuzed or unfuzed) Ordnance	Surface
		Burial	Unfired (fuzed or unfuzed) Ordnance, possible retrograde	Subsurface Other Constituents
		Burn Pit	Incompletely Burned OE, OE Residue	Subsurface Other Constituents
	Impact/Target Areas	Firing – Incomplete Detonation	Frag, Pieces of OE	Surface Subsurface Other Constituents
		Firing – Dud Fired	UXO, UXO Components	Surface Subsurface Other Constituents
		Firing – Complete Detonation	Frag	Surface Subsurface
	Range Safety Fans	Firing – Incomplete Detonation	Frag, Pieces of OE	Surface Subsurface Other Constituents
		Firing – Dud Fired	UXO, UXO Components	Surface Subsurface
		Firing – Complete Detonation	Frag	Surface Subsurface
	Aerial Bombing Range	Dropping – Incomplete Detonation	Frag, Pieces of OE	Near-Coastal Waters Surface Subsurface Other Constituents
		Dropping – Dud Fired	UXO, UXO Components	Near-Coastal Waters Surface Subsurface
		Dropping – Complete Detonation	Frag	Near-Coastal Waters Surface Subsurface
Troop Training	Combat Range	Mishandling or Loss	Unfired (fuzed or unfuzed) ordnance	Surface
		Burial	Unfired (fuzed or unfuzed) Ordnance, possible retrograde	Subsurface Other Constituents
		Firing – Incomplete Detonation	Frag, Pieces of OE	Surface Subsurface Other Constituents
		Firing – Dud Fired	UXO, UXO Components	Surface Subsurface
		Firing – Complete Detonation	Frag	Surface Subsurface
	Bivouac and Encampment Areas	Mishandling or Loss	Unfired (fuzed or unfuzed) ordnance	Surface
		Burial	Unfired (fuzed or unfuzed) ordnance, possibly retrograde	Subsurface Other Constituents
Defensive Positions	Minefields	Placement	Undetonated, fuzed mines	Surface Subsurface Other Constituents
	Gun Emplacements	Mishandling, Loss or Abandonment	Unfired (fuzed or unfuzed) Ordnance	Surface
		Burial	Unfired (fuzed or unfuzed) Ordnance, possible retrograde	Subsurface Other Constituents
		Burn Pit	Incompletely Burned OE, OE Residue	Subsurface Other Constituents
Sanctioned Ordnance Disposal	Mass Burial/Landfills with OE/UXO	Burial	Unfired (fuzed or unfuzed) Ordnance, possibly retrograde; UXO; OE	Subsurface Other Constituents
	Open Burn/Open Detonation (OB/OD)	Kick-Out/ Incomplete Detonation (OD)	UXO, UXO Components, OE	Surface Subsurface Other Constituents
		Burning	Incompletely burned OE, OE Contaminated Scrap, OE Residue	Surface Subsurface Other Constituents
	Aerial Bomb Jettison Area	Dropping – Incomplete Detonation	Frag, Pieces of OE	Near-Coastal Waters Surface Subsurface Other Constituents
		Dropping – Dud Fired	UXO, UXO Components	Near-Coastal Waters Surface Subsurface
		Dropping – Complete Detonation	Frag	Near-Coastal Waters Surface Subsurface

[1/]Other constituents requirements will be determined as part of the Level 2 sampling methodology criteria, especially the potential type and amount of OE associated with an AOC.

Conceptual Model of Exposure Pathways



[1]Ground surface (as defined): For some users “ground surface” may include incidental subsurface intrusion (e.g., placing tent stakes).
[2]OE residue on the surface may give an exposure pathway to inland surface waters through erosion and run-off.

Figure 4-1. Conceptual Site Model for Adak OU B—Ordnance

TABLE 4-1
Summary of Approved Level 2 Investigation Approach by AOC Type Presented in OU B-1 RI/FS Report

AOC Type	Site Assessment/Reconnaissance	Site Inspection	Site Characterization
Aerial Bombing Range	N/A for current RI because sites of this type have moved beyond site inspection.	Geophysical mapping along ribbon walk evenly distributed in suspected range area and intrusive investigation of target anomalies identified. Follow up on trigger items with 30-m x 30-m grids to locate high-density areas of MEC.	Geophysical mapping along ribbon walk placed to locate boundaries of the range. 100% geophysical mapping of 30-m x 30-m grids as needed to obtain sufficient data for FS.
Firing Point	N/A for current RI because sites of this type have moved beyond site inspection.	Instrument-aided inspection of the site and intrusive investigation of target anomalies identified.	100% geophysical mapping of 30-m x 30-m grids covering the site. Intrusive investigation of all potential munitions-related anomalies. Characterization is complete when no MEC or MPPEH is found within 15 meters of the boundary (based on expansion grid process). MC sampling if evidence of burn pad or exposed ordnance filler is found.
Large-Scale Burial/ Disposal Area	N/A for current RI because sites of this type have moved beyond site inspection.	100% geophysical mapping with maximum transect spacing based on the smallest munition of interest for the area (if known). Intrusive investigation of all potential munitions-related anomalies. Follow up on trigger items with 30-m x 30-m expansion grids.	100% geophysical mapping of 30-m x 30-m grids covering the site. Intrusive investigation of all potential munitions-related anomalies. Characterization is complete when no MEC or MPPEH is found within 15 meters of the boundary (based on expansion grid process). MC sampling if evidence of burn pad or exposed ordnance filler is found.
OB/OD Areas	N/A for current RI because sites of this type have moved beyond site inspection.	Grid-based mag & dig investigation or mapping of transects spaced at 34.5 meters in all areas. Intrusive investigation of potential munitions-related anomalies. Follow up on trigger items with 30-m x 30-m expansion grids.	100% geophysical mapping of 30-m x 30-m grids covering the site. Intrusive investigation of all potential munitions-related anomalies. Characterization is complete when no MEC or MPPEH is found within 15 meters of the boundary (based on expansion grid process). MC sampling if evidence of burn pad or exposed ordnance filler is found.
Storage Magazine/ Ammunition Supply Point	Instrument-aided reconnaissance of site using 5-m maximum transect spacing. Spacing will be decreased where visibility is reduced.	Geophysical mapping using transects spaced at 34.5 meters in all areas. Follow up on trigger items with 30-m x 30-m expansion grids.	100% geophysical mapping of 30-m x 30-m grids covering the site. Intrusive investigation of all potential munitions-related anomalies. Characterization is complete when no MEC or MPPEH is found within 15 meters of the boundary (based on expansion grid process). MC sampling if evidence of burn pad or exposed ordnance filler is found.

TABLE 4-1
Summary of Approved Level 2 Investigation Approach by AOC Type Presented in OU B-1 RI/FS Report

AOC Type	Site Assessment/Reconnaissance	Site Inspection	Site Characterization
Target/Impact Area	N/A for current RI because sites of this type have moved beyond site inspection.	Geophysical mapping using a maximum transect spacing based on the smallest munition of interest for the area. Intrusive investigation of potential munitions-related anomalies. 100% geophysical mapping of 30-m x 30-m grids placed where more detailed anomaly or MEC characteristics are desired.	100% geophysical mapping of accessible areas using a maximum transect spacing based on the smallest munition of interest for the area. Intrusive investigation of all potential munitions-related anomalies. Characterization is complete when no MEC or MPPEH is found within 15 meters of the boundary (based on expansion grid process). 100% geophysical mapping of 30-m x 30-m grids placed where more detailed anomaly or MEC characteristics are desired. MC sampling if evidence of burn pad or exposed ordnance filler is found.

Note:
Additional AOC types were identified at OU B-2 (Range Buffer Area, Small Arms Range, Storage Area, and Wash-up Area for Offshore Disposal) after the OU B-1 R/FS Report was submitted. The Level 2 Investigation approaches for Target/Impact Areas, Firing Points, Storage Magazines, and Large Scale Burial/Disposal Areas were used for these AOC types.

TABLE 4-2
Level 2 Methodology Transect Spacing for Specific Munitions

	Hazardous Frag Distance*			Transect Spacing	
Projectile	Meters	Feet	Factor	Calculated	Recommended
20 mm	37	121	55.0%	22.0	20 m
37 mm	77	253	27.5%	21.0	20 m
40 mm	88	289	27.5%	24.0	25 m
75 mm	157	516	27.5%	45.0	50 m
90 mm	196	643	27.5%	54.0	50 m
105 mm	288	945	27.5%	79.0	80 m
155 mm	417	1,368	27.5%	115.0	115 m
60 mm mortar	--	--	--	--	34.5 m
81 mm mortar	--	--	--	--	58 m

*As determined by OU B Project Team—Hazardous Assessment Working Group (2000).

4.2.3 Site Characterization

Site characterization was identified as a concept for sites requiring a hazard assessment or evaluation in an FS. Site characterization involves a more detailed evaluation, with more technically advanced methods, to provide more comprehensive data. The goals of the Level 2 methodology site characterization were to:

- More accurately bound/delineate ordnance contamination
- Estimate the quantity/density of ordnance
- Characterize the type and condition of the ordnance present
- Sample for ordnance constituents in appropriate locations

Data obtained from site reconnaissance and site inspection were used to specify type of ordnance and AOC type, which were then used—in conjunction with the established probability of detection (Pd) of the survey equipment—to determine a transect spacing (investigation pattern) appropriate for geophysical mapping during AOC characterization. The site characterization process includes field acquisition of geophysical data, processing of those data, and intrusive investigation of targeted anomalies. Identification and classification of target anomalies provide data for subsequent hazard assessment and FS evaluations. The field activities used during the RI to complete site characterization for MEC include transects, grids, and expansion grids, as described below.

4.2.3.1 Transects

Transects (roughly parallel) were selected as the most efficient survey/mapping pattern for use in characterizing target/impact areas where clusters (concentrations) of UXO were anticipated to be present. An appropriate transect spacing was developed for each AOC based on ordnance characteristics and distribution, as well as the area size and geometry. The goal was to provide the highest probability of finding evidence of ordnance in an AOC. The transect spacing for target/impact areas was developed based on information from U.S. Army field manuals and distribution calculations, which determine impact probability and associated lethal areas for different ordnance types.

Ordnance detonation areas can be plotted as lethal circles. The distance across a group of circles represents a hypothetical impact area. An ellipse can be drawn around the group of lethal circles in the hypothetical impact area, and the distance across the minor axis of the ellipse was used to generate the transect spacing for the particular ordnance type in that area. Seventy-five percent of this distance was judged adequate to provide a sufficient transect spacing to allow MPPEH detection in an impact area. For a 60-mm mortar, for instance (one of the more common munitions found on Adak), the distance across the minor axis of the ellipse is 46 meters (151 feet). Transect spacing designed to detect a 60-mm mortar impact area would be 75 percent of 46 meters (151 feet) or 34.5 meters (113 feet). Using the same approach, a transect spacing of 58 meters (190 feet) was calculated for the 81-mm mortar systems. Transect spacing for AOCs containing large-caliber ordnance types (other than mortars) was based on the weight of the munition, the trinitrotoluene (TNT) equivalent weight, and explosive quantity safety distance. Specific details of the development of these transect spacings are contained in the Level 2 ordnance and explosives sampling methodology (OU B Project Team—Hazard Assessment Working Group, 2000).

4.2.3.2 Grids

For some types of AOCs, such as storage magazines or disposal sites, it was not possible to identify a predicted distribution pattern for ordnance. Grid-based sampling was selected as the most efficient approach for these areas. Complete mapping (100 percent coverage) of accessible areas where items of interest were found during site reconnaissance or where site inspection was deemed the best way to determine whether ordnance is present and to bound and characterize those materials. The standard grid size selected in the Level 2 methodology was a 30-m by 30-m grid. In practice, multiple grids were often used to provide full coverage of an AOC or of areas of interest within the AOC. In some cases, an irregular mapping area covering the AOC or areas of interest was used to facilitate refinement of AOC boundaries.

4.2.3.3 Star Pattern/Expansion Grids

During the initial RI, the appropriately spaced transect pattern for a given AOC was to be performed first. If UXO, DMM, or MPPEH (collectively referred to as trigger items) were identified during the initial transect mapping, the area of the find(s) was subject to a second investigation using transects set in a star pattern (also called an X-T). A star pattern incorporated a set of four 15-m (49-ft) positional transects forming a star pattern over the find. If trigger items were identified during investigation of the star pattern transect, another star pattern was executed that was centered on the new find(s). This procedure continued until no trigger items were found for 15 meters (49 feet).

The star pattern proved to be difficult to execute in the field. By consensus of the Project Team, it was replaced with a 30-m by 30-m grid that was executed using transects spaced at 5 meters (16 feet). This expansion grid pattern of investigation (referred to as the expansion grid process) provided the necessary information and was much easier to execute. The expansion grid pattern was employed at previously identified MEC locations in several AOCs during the 2008 RI. Step-out transects rather than expansion grids were then used to determine the extent of MEC (as appropriate) during the 2008 RI. The step-out transects consisted of parallel transects extending from the grid boundary (or boundaries) where MEC was found. The transects were extended until no MEC items were encountered for 15 m, or until the transects were 45 meters long. The use of step-out transects at MI-02 was discussed in an August 21, 2008, meeting and finalized in FCR 17 (see Sections 5.2 and 5.3).

4.3 AOC Descriptions

This section summarizes the physical features and known or potential ordnance-related characteristics of the OU B-2 AOCs. It also provides other data and information relevant to development and execution of the Level 2 methodology at the OU B-2 AOCs. Each AOC summary includes the following:

- A discussion of each AOC as it relates to the Adak CSM
- A summary of past investigations in each AOC
- A description of the approved Level 2 methodology for each AOC
- A description of the adequacy of past investigations to meet the Level 2 requirements for each AOC
- Any known or perceived data gaps to be filled during the 2008 RI

AOC locations are shown in Figures 2-1, 2-2, and 2-3.

4.3.1 ALDA-01 Andrew Lake Disposal Area

ALDA-01 is located at the northwest corner of Andrew Lake. The AOC boundary is dog-legged and is wider at the north end of the site near Andrew Bay. Most of this AOC lies at elevations ranging from about 6.1 to 12.2 meters (20 to 40 feet) asl; however, a cliff on the west side of this AOC rises to heights of more than 200 feet asl. Several craters are present in this area. This AOC is bordered by ALDA-02 (the Andrew Lake Beach Crater Area) to the west, Andrew Lake to the east, ALSW-01 (the Andrew Lake Seawall) to the northeast, and a thin strip of ALSW-01 to the north. Parcel 4 areas outside of OU B-2 border this AOC to the southwest. Site characterization information for this AOC is presented in Table 4-3, and the results of previous investigations are summarized in Table 4-4.

Trench Excavation in ALDA-01

TABLE 4-3
Summary of ALDA-01 CSM and Characterization Parameters

Total AOC Area:	**6.7 acres** **Accessible AOC Area:** **4.7 acres, remainder inaccessible due to steep slopes**
Access	Direct via main access road running along the western shore of Andrew Lake. This road is gated with a locking steel gate near the south end of the lake to deter general access.
Terrain	Generally flat; steep slopes along the western edge. A line of craters trends northwest to southeast across the site. Cobbles and boulders are prevalent.
Vegetation	Predominantly grass ranging in height from 12 to 18 inches; sparser toward the beach area, but still thick enough to hide the underlying cobbled surface.
Hydrology/Surface Water	No known runoff channels or surface water.
Geology/Hydrogeology	Shallow bedrock with a thin layer of soil. The soil is dominated by cobbles and boulders. There should be no groundwater because of the shallow bedrock.
Initial AOC Type	Large-Scale Burial Area and OB/OD Area.
Adjusted AOC Type	Debris disposal area with possible bombing and OB/OD craters, with possible wash-up of MEC from offshore area.

TABLE 4-3
Summary of ALDA-01 CSM and Characterization Parameters

Target Munitions	Primarily 60-mm mortars.
Unique Features	Cobbles, craters, large non-munitions-related debris, and dense geophysical anomalies.
Potential Transport Mechanisms	Intrusive human activities, erosion along beach headwall and steeply sloped crater walls
Sensitive Ecological Habitats	The nearby beach area provides foraging opportunities for several species of birds, including the bald eagle, several species of gulls, and the rock sandpiper.
Approved Level 2 Methodology (2000)	Large-Scale Burial Area approach using multiple 30-m grids.
Previous MEC Investigation	100% geophysical survey of accessible area; intrusive investigation of 86 anomalies in 5 trenches (to a depth of 4 feet) and at 31 additional discrete locations (~5%); craters not surveyed.
Previous MC Sampling	None.
Applicability of Previous Work	100% survey satisfies Level 2 requirement. Investigation of ~5% of anomalies only partially satisfies investigation requirements; however, sufficient MEC data are available for hazard analysis and FS evaluation. MC data needed for soil.
Data Gaps	No MEC data for the craters in this AOC are available to support evaluation of the source of these man-made terrain features (i.e., are they the result of disposal operations or bombing runs suspected to have taken place in ALDA-02 to the west?). No data are available for this AOC (including the crater area) to support potential presence or transport of MC. Erosion has been noted along the northern boundary of this AOC; however, these observations have been too limited to support evaluation of the potential for transport/migration of MEC or MC out of the AOC.

TABLE 4-4
Summary of Previous MEC Investigation Findings for ALDA-01

			Depth (below ground surface)			
Items Identified	**Total Number**	**Surface**	**0 to 0.5 feet**	**0.5 to 2 feet**	**2 to 4 feet**	**> 4 feet**
UXO	3	3	0	0	0	0
DMM	7	6	0	1	0	0
MPPEH	1	0	0	1	0	0
MD	26	0	1	24	1	
Other	18	8	0	8	2	0

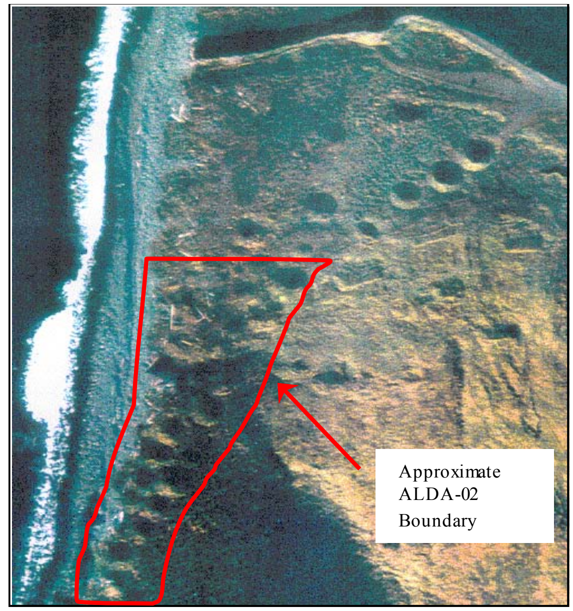
Items found:*

UXO	60-mm mortar (3)
DMM	40-mm MKII projectile – unfuzed, unfired Mortar (4) (no other description) Bomb (2) (no other description)
MPPEH	M47A2 incendiary gasoline gel bomb case w/ possible burster tube and residue

*Information in this table is provided to identify the type and depths of ordnance recovered only. It is not intended to be a formal inventory.

4.3.2 ALDA-02 Andrew Lake Beach Crater Area

ALDA-02 is located adjacent to the beaches of Andrew Bay and northwest of Andrew Lake in the northwestern portion of OU B-2. The area is roughly rectangular, with the long sides of the rectangle running parallel to the Andrew Bay shoreline. Elevations in ALDA-02 range from about 6.1 to 61 meters (20 to 220 feet) asl, with the vast majority of the elevation gain in the form of a cliff along the southern edge of the AOC. This AOC is bordered by ALDA-01 to the east and by C1-01 to the southwest. Relevant data and information for this AOC are summarized in Table 4-5.



ALDA-02

TABLE 4-5
Summary of ALDA-02 CSM and Characterization Parameters

Total AOC Area:	**9.5 acres**	**Accessible AOC Area:**	**< 1 acre, remainder inaccessible due to steep slopes and cliffs**

Access	Indirect via overland walk from the main access road running along the western shore of Andrew Lake to the east of this AOC. This road is gated with a locking steel gate near the south end of the lake to deter general access.
Terrain	Rolling and irregular transitions over a strip approximately 50 meters wide from a cobble beach in the north to a rocky cliff in the south.
Vegetation	Tall grass, thick at most locations, impedes access and hides holes and hummocks in the uneven terrain.
Hydrology/Surface Water	An ephemeral drainage channel from C1-01 cuts across ALDA-02, outfalling over a cliff to a rocky shelf beside Andrew Bay.
Geology/Hydrogeology	Predominantly bedrock with a very thin layer of soil overtop. There should be limited groundwater because of the shallow bedrock.
Initial AOC Type	Potential aerial bombing range based on review of aerial photography showing craters in the AOC; however, there were no targets present in the photographs. The craters form a long straight line that is atypical of an aerial bombing range with a target.
Adjusted AOC Type	No adjustment. The long line of craters suggested use of this area for a very limited number of Rolling Thunder bombing practice runs, which do not use targets. Conditions noted during field reconnaissance (rugged terrain, exposed bedrock, and inaccessibility) supported initial estimation of the probable historical use. However, recently-acquired (2012) historical aerial photograph analysis also suggests possible debris disposal and MEC detonation in the area.
Target Munitions	Large bombs.
Unique Features	Very irregular, rugged terrain with craters and hummocks hidden beneath tall grass; exposed bedrock.
Potential Transport Mechanisms	Intrusive human activities (limited due to small size of accessible area).
Sensitive Ecological Habitats	The nearby beach area provides foraging opportunities for several species of birds, including the bald eagle, several species of gulls, and the rock sandpiper.

TABLE 4-5
Summary of ALDA-02 CSM and Characterization Parameters

Approved Level 2 Methodology (2000)	Aerial bombing range approach.
Previous MEC Investigation	Visual observation during site walks by Project Team members and UXO professionals.
Previous MC Investigation	None.
Applicability of Previous Work	Site walk for visual evaluation does not meet requirements for Level 2 methodology for this type of AOC; however, because investigation would be very difficult in this AOC and bedrock is shallow (promoting high-order detonation of any bombs dropped), the Project Team has approved NOFA for MEC.
Data Gaps	No direct physical MEC data are available for the craters in this AOC to verify the source of these man-made terrain features (i.e., are they related to the Rolling Thunder bombing runs suspected to have taken place in this AOC?).

4.3.3 ALSW-01 Andrew Lake Seawall

Andrew Lake Seawall Looking Southwest from Mt. Adagdak Toward the Base of Mt. Moffett

ALSW-01 consists of the western portion of the seawall located along the north shoreline of Andrew Lake. The seawall is narrow and elongated, similar to a dike with a narrow, flat top and steep sides. The seawall separates the freshwater lake from Andrew Bay to the north, which is an embayment of the Bering Sea. A munitions dump is located offshore of the seawall. The location and amount of munitions in the offshore dump area are unknown. Elevations in the upland portion of the AOC range from about 3 to 9.1 meters (10 to 30 feet) asl. This AOC is bordered by ALDA-01 to the west, Andrew Lake to the south, the Andrew Bay beach area to the north, and non-OU B-2 areas to the east. The Navy periodically performs sweeps on the Andrew Bay beach, within the tidal zone, to remove MEC items that have washed up from offshore dump sites. The area below the mean higher high water mark on the Andrew Bay side of the seawall is owned by the Alaska Department of Natural Resources. Relevant data and information for this AOC are summarized in Tables 4-6 and 4-7.

TABLE 4-6
Summary of ALSW-01 CSM and Characterization Parameters

Total AOC Area:	**Up to 270 acres, inclusive of offshore area**	**Accessible AOC Area:**	**21 acres, remainder is offshore marine area.**
Access	Direct via unimproved road originating on the east side of Andrew Lake near the Recreation Center. There is a locked steel gate on this roadway just north of the Recreation Center to deter public access. Also, indirect access via walk from main access road running along the western shore of Andrew Lake. This road is gated (locked steel gate) near the south end of the lake to deter general access. There are no access restrictions to the offshore portions of the site.		
Terrain	Transitions from generally flat atop the seawall to very steep along the sides (north and south). Shoreline is steeply sloped with several wave-cut benches.		

TABLE 4-6
Summary of ALSW-01 CSM and Characterization Parameters

Vegetation	Absent except for upland portion of terrestrial area, upland vegetation consists of short, relatively sparse grass atop the wall and tussocks of taller grass along the sides where adequate soil is present. In the intertidal and marine areas, vegetation is limited to rockweed and kelp along the rocky segments of the shoreline. Kelp beds extend out hundreds of meters from the shoreline. The presence of kelp beds typically varies throughout the year, with kelp thickest in the late summer and early fall, and much reduced during the winter, as large winter storms tend to tear kelp from the seabed.
Hydrology/Surface Water	Natural spillway at the northwest corner of Andrew Lake allows some flow of freshwater into Andrew Bay. At times, the spillway is obstructed and discharge is limited to water flowing through the cobble substrate of the seawall to Andrew Bay.
Geology/Hydrogeology	Terrestrial Area: Natural spit or berm constructed of moderately sorted, rounded to well-rounded boulder and cobble gravel that may have been reinforced by the addition of metal debris and wood. Intertidal and Marine Areas: The composition of the bottom through the tidelands and into submerged lands was reported as a solid layer of boulders out to a water depth of approximately 50 feet. Mixed sand and rock were noted at depths of 50 to 100 feet.
Initial AOC Type	No direct fit in AOC types. Wash-up area for offshore MEC.
Adjusted AOC Type	Wash-up area for offshore MEC disposal and potential upland disposal area (burial).
Target Munitions	Primarily 60-mm and 81-mm mortars.
Unique Features	Cobbles in the beach area, steep side slopes of the seawall; two streams crossing ALSW-01 to enter Andrew Bay; natural spillway for Andrew Lake at the northwest corner of the lake. Seawall contains abundant large non-munitions-related metal debris.
Potential Transport Mechanisms	Intrusive and non-intrusive (beach combing) human activities; wave action and storm surge.
Sensitive Ecological Habitats	The beach area provides foraging opportunities for several species of birds, including the bald eagle, several species of gulls, and the rock sandpiper. Marine mammals are found in the bays and harbors of Adak Island, both year-round and on a migratory basis, and include the harbor seal, orca, northern harbor porpoise, Dall's porpoise, sperm whale, Baird's beaked whale, goosebeaked whale, gray whale, minke whale, fin whale, humpback whale, right whale, sea otter, and Steller's sea lion. Marine aquatic resources are abundant in Andrew Bay. These include several species of crustacea, mollusks, echinoderms, bivalves, and fish that inhabit the area. Additionally, USFWS reports that three streams on the west side of Andrew Lake, including Moffett Creek, support several species of anadromous fish (for example, Coho salmon) that are expected to migrate through Andrew Bay.
Approved Level 2 Methodology (2000)	Large-Scale Burial Area approach using 30-m grid centered on potential disposal site.
Previous MEC Investigation	Yearly visual or instrument-aided surface sweeps along the beach areas.
Previous MC Investigation	None.
Applicability of Previous Work	Yearly sweeps do not satisfy the requirements for characterization. While characterization will not yield information regarding offshore ordnance sources, it will provide data for analysis of the potential for upland disposal activities.
Data Gaps	No MEC data are available for this AOC except data generated from beach sweeps covering the northern boundary area. MEC data are needed to verify the AOC type and bound and to characterize the AOC. No data are available for this AOC to support evaluation of potential presence or transport of MC within two principal runoff ravines that cross the AOC. If breached munitions are found during investigation of the possible small-arms burial location, insufficient data will be available to support evaluation of potential presence or transport of MC. The location and amount of MEC in the offshore area is unknown.

TABLE 4-7
Summary of Previous Investigation Findings for ALSW-01 (1962 – 2009 Beach Sweeps)

Time Frame[a]	60-mm Mortar	81-mm Mortar	Bomb	Fuzes	Grenades	Projectiles	MPPEH/ Misc
1962–1967	68	363	47	23	14	95	7
1971–1975	0	3	6	7	0	1	0
1979–1992	8	24	25	9	5	40	23
2004–2009	0	45	0	19	0	4	46
Totals	**76**	**435**	**78**	**58**	**19**	**140**	**76**

Item names, as recorded in beach sweep reports (may not be consistent with formal munitions terminology):

Mortars	60-mm mortar	61-mm mortar rounds, HE. Fused
	60-mm mortar (HE)	Mortar, 60-mm
	60-mm mortars	Partial 60-mm mortar
	60-mm powder casings	81-mm mortar rounds (heavy) HE. or WP fuzed
	80-mm mortar round	81-mm mortar WP
	81-mm Hi Capacity mortars	81-mm mortars
	81-mm mortar	Mortar tail booms
	81-mm mortar (WP)	Mortar, 81-mm, HE and WP M43, light
	81-mm mortar M43A1	Mortar, 81-mm, HE and WP M56, heavy
	81-mm mortar round	Mortars
	81-mm mortar rounds (light) H.E. Fused	
Bombs	1000-pound (lb) GP. bomb M-65 unfuzed	Fuze, bomb AN/M-100 A1
	4-lb incendiary bomb, AN-M50A2/6	Fuze, bomb AN/M-103 A1
	500-lb incendiary bombs M-76	Incendiary
	750-lb, SAP bomb M-58 unfuzed	Incendiary firebombs
	A/N M52A1 thermite bomblets	M52 incendiary bombs
	Bomb, incendiary, 4-lb	Thermite bomblets
Fuzes	103 bomb fuzes	Fuzes
	AN-M112 Series Fuses	M-100 bomb tail fuzes
	Bomb fuzes	M103 bomb fuze
	Bomb tail fuze	M-103 bomb nose fuzes
	Fuze of unknown type	Projectile fuzes
Grenades	Grenade fuzes	Grenades, rifle, HEAT, fuzed
	Grenades, frag.	MK2 hand grenade, fuzed
	Grenades, rifle, HEAT	Thermite grenades
Projectiles	2.36-inch rockets HEAT, Fused	40-mm projectiles, fuzed
	3-inch projectiles	40-mm, HEI (complete round)
	3.5-inch rocket mortar	40-mm, HEI (projectiles)
	30-mm shell casings (primers intact)	5-inch bombardment rocket Head
	37-mm projectiles	5-inch shell cases
	40-mm casings	57-mm ammo.
	40-mm complete rounds	6-inch projectiles
	40-mm cartridges, complete, fuzed	75-mm shell cases
	40-mm fuze and shell	Assorted 60- and 75-mm powder casings
	40-mm powder casing	Projectile, 90-mm
	40-mm powder casings	Projectiles
MPPEH/Misc.	Burster	MK4 A/C float lights
	Burster tube	MK5 CS carts
	Bursters	Old bulk explosives
	CADs	Ordnance items
	Firing device	Parachute flare MK5
	105-mm casings	

4.3.4 BC-03 Blind Cove/Camper's Cove Firing Point 1

This AOC is located atop the seawall, near the center of the dike-like feature. This AOC is a small, roughly square site that is surrounded on all sides by land that is not part of OU B-2. The elevation of BC-03 is about 9.1 meters (30 feet) asl. A small portion of this AOC was inaccessible for investigation because of the presence of Quonset hut debris. Relevant data and information for this AOC are summarized in Tables 4-8 and 4-9.

TABLE 4-8
Summary of BC-03 CSM and Characterization Parameters

Total AOC Area:	0.2 acre Accessible AOC Area: ~0.16 acre
Access	Indirect via unimproved road originating on the east side of Andrew Lake near the Recreation Center. There is a locked steel gate on this roadway just north of the Recreation Center to deter public access.
Terrain	Relatively flat.
Vegetation	Relatively sparse because of the unsuitability of the soils to sustain vegetation; grasses 8 to 18 inches tall.
Hydrology/Surface Water	No known runoff channels or surface water.
Geology/Hydrogeology	Geology and hydrogeology are expected to be similar to terrestrial portion of ALSW-01, which is a man-made feature composed of boulders, cobbles, gravel, large metal debris, and wood.
Initial AOC Type	Firing point.
Adjusted AOC Type	No adjustment.
Target Munitions	155-mm projectiles.
Unique Features	Location atop seawall.
Potential Transport Mechanisms	Intrusive human activities.
Sensitive Eco Receptors	The beach area provides foraging opportunities for several species of birds, including the bald eagle, several species of gulls, and the rock sandpiper.
Approved Level 2 Methodology (2000)	Firing point approach.
Previous MEC Investigation	100% instrument-aided reconnaissance in accessible areas. All contacts intrusively investigated to maximum depth of 4 feet.
Previous MC Investigation	None.
Applicability of Previous Work	Level 2 methodology requirements fulfilled.
Data Gaps	No data gaps were identified for this AOC. The Project Team has approved this site for NOFA.

TABLE 4-9
Summary of Previous Investigation Findings for BC-03

Items Identified	Total Number	Surface	Depth (below ground surface)			
			0 to 0.5 feet	1 to 2 feet	2 to 4 feet	> 4 feet
UXO	0	0	0	0	0	0
DMM	0	0	0	0	0	0
MPPEH	0	0	0	0	0	0
MD	0	0	0	0	0	0
Other	31	0	31	0	0	0

4.3.5 C1-01 Combat Range 1 Mortar Impact Area

C1-01 is located north of the former Range Complex at Andrew Lake. It is roughly oval in shape. C1-01 is situated on a sloping plateau above and west of ALDA-01 on the flanks of Mt. Moffett. Elevations range from about 152 to 396 meters (500 to 1,300 feet) asl. It is bordered on all sides by AOPC C1-03 (Combat Range 1 – Remainder). ALDA-01 and ALDA-02 are located northeast of this AOC, and Andrew Lake lies to the east. Relevant data and information for this AOC are summarized in Tables 4-10 and 4-11.

C1-01 Looking East Toward the Seawall and Andrew Bay

TABLE 4-10
Summary of C1-01 CSM and Characterization Parameters

Total AOC Area:	**387 acres Accessible AOC Area: 350 acres, remainder inaccessible due to steep slopes**
Access	Indirect access via moderate hike from the Andrew Lake range area. Access to the range area is via a locked steel gate near the south end of Andrew Lake.
Terrain	Moderately steep and rocky in most areas. Inaccessible along northern boundary.
Vegetation	Tundra and sparse short grasses, lichens, and small alpine flowers ranging in height from 1 to 4 feet.
Hydrology/Surface Water	An ephemeral drainage channel cuts across C1-01, outfalling north over a steep cliff to a rocky shelf beside Andrew Bay. Several small discontinuous wetlands have been mapped in the area.
Geology/Hydrogeology	Shallow soils with rock outcrops. Groundwater is anticipated to be deep due to elevation of AOC (500 to 1,300 feet) relative to nearby permanent surface water features at Andrew Bay and Andrew Lake.
Initial AOC Type	Combat Range/Maneuver Area.
Adjusted AOC Type	Target/Impact Area.
Target Munitions	20-mm, 37-mm, and 40-mm projectiles; 60-mm and 81-mm mortars.
Unique Features	Steep cliff on north side; slumping and erosion features, stream channels.
Potential Transport Mechanisms	Intrusive human activities; overland flow and runoff; erosion in the ravines and frost heave.
Sensitive Ecological Habitats	Andrew Lake (also Andrew Bay, which is not identified as sensitive).
Approved Level 2 Methodology (2000)	Target/Impact Area approach using transect spacing for 20-mm projectiles.
Previous MEC Investigation	Ribbon-walk geophysical survey followed by mapping of 45.5 miles using the 34.5-m transect pattern to fill in gaps in the characterization pattern for 60-mm mortars (believed to be the smallest munitions in C1-01 at the time of the investigation); intrusive investigation of 650+ anomalies (100%) to maximum depth of 4 feet.
Previous MC Investigation	Sampling at two sites where breached munitions were found. One additional find identified that may have been a breached item; no sampling.
Applicability of Previous Work	Survey does not completely fulfill requirements for survey using 20-m spacing as required for a 20-mm impact area; however, sufficient MEC data are available to bound the area and to perform hazard analysis and FS evaluation.
Data Gaps	MEC data were collected at a spacing greater than that specified for 20-mm projectiles; however, ample data are available to bound and characterize the AOC and to support hazard analysis and FS evaluation. Insufficient data are available for this AOC to support evaluation of potential presence or transport of MC. Further boundary definition may be required on the eastern side of the AOC if this area is accessible (slopes less than 30 degrees). No visual observations have been made regarding erosion features that might indicate potential for transport/migration of MEC out of C1-01.

TABLE 4-11
Summary of Previous MEC Investigation Findings for C1-01

Items Identified	Total Number	Surface	Depth (below ground surface)			
			0 to 0.5 feet	0.5 to 2 feet	2 to 4 feet	> 4 feet
UXO	8	5	1	2	0	0
DMM	1	0	1	0	0	0
MPPEH	12	4	4	4	0	0
MD	337	50	178	105	4	0
Other	18	12	2	4	0	0
Items found:*						
DMM	MK45 VT fuze					
UXO	81-mm mortar, HE, no fuze, fired 20-mm HEI, fired, armed 20-mm M253 HEI projectile, armed (2) 81-mm mortar 20-mm projectile, w/ fuze, fired, armed 60-mm mortar, PD fuze, fired 81-mm mortar, HE, fired, no fuze 60-mm mortar, HE, M49 (possible w/M52 PD fuze)					
MPPEH	60-mm mortar, HE, no nose fuze, no tail boom, mortar cavity mostly hollow w/ pieces of HE 81-mm WP, tail boom cracked off, exposing WP, fired 40-mm MK27 projectile fuze 20-mm projectile (5) 37-mm projectile w/ tracer element Fire bomb weight (2) Bottom half of 37-mm projectile 40-mm projectile, no fuze, HE residue M100 series bomb fuze w/M14 primer detonator					

*Information in this table is provided to identify the type and depths of ordnance recovered only. It is not intended to be a formal inventory.

4.3.6 HG-01 Andrew Lake Hand Grenade Range

HG-01 is a small, square area of about 2 acres located within the former Range Complex at Andrew Lake. Remnants of a berm with incorporated throwing pits are located near the east side of the range. The pits are reinforced with heavy timbers and, at one time, offered protection from exploding grenades during training exercises. The elevation in this AOC is approximately 33.5 meters (110 feet) asl. This AOC is located wholly within RR-01 (the Andrew Lake Hand Grenade/40 mm Impact Area). Relevant data and information for this AOC are summarized in Tables 4-12 and 4-13.

Looking West Across HG-01 from the Throwing Pit Area Toward Mt. Moffett

TABLE 4-12
Summary of HG-01 CSM and Characterization Parameters

Total AOC Area:	**2 acres** **Accessible AOC Area: 1.8 acres**
Access	Direct via gravel range entry road, which branches from the main access road along the western side of Andrew Lake. This main road is gated (locked steel gate) near the south end of the lake to deter general access. A locked cable barrier also deters access to the range entry road.
Terrain	Relatively flat with tall tundra growth. There are steep slopes on the berm protecting the throwing pits.
Vegetation	Tall with tundra grasses up to 18 inches tall interspersed with wildflowers.
Hydrology/Surface Water	Moffett Creek runs from west to northeast through the northern portion of this AOC. Lowland areas bordering this creek are often saturated with pooled water at certain times of the year. Wetland vegetation and soils are present through much of the RAA. Groundwater is in hydraulic communication with the creek.
Geology/Hydrogeology	Valley floor is composed of a silty, gravelly, sand, alluvial/colluvial, and/or outwash material overlying andesitic basalt bedrock or consolidated ash tuff. Groundwater is anticipated to be shallow, and there may be intermittent standing water at certain times of the year.
Initial AOC Type	Target/Impact Area.
Adjusted AOC Type	Target/Impact Area.
Target Munitions	40-mm grenades; 60-mm mortars; hand grenades.
Unique Features	Moffett Creek; wetlands; some steep slopes. Timber-reinforced throwing pits in protective berm. The grenade range is considered a cultural resource.
Potential Transport Mechanisms	Intrusive human activities; erosion; overland transport by Moffett Creek, which runs through the area.
Sensitive Ecological Habitats	Tundra, Andrew Lake, and associated fish-bearing streams; wetlands.
Approved Level 2 Methodology (2000)	Target/Impact Area approach for 60-mm mortar.
Previous MEC Investigation	80% geophysical survey of accessible AOC; intrusive investigation of 146 anomalies (86%) to a maximum depth of 4 feet.
Previous MC Investigation	None.
Applicability of Previous Work	80% survey in accessible areas satisfies survey requirement; investigation of 86% of targets partially satisfies intrusive investigation requirements.
Data Gaps	Not all target anomalies were intrusively investigated during the 1999 SI. Twenty-five anomalies remain to be evaluated, although geophysical survey of this area generated more anomalies than would have been found using the prescribed transect-based methodology for a Target/Impact Area. If additional target investigation yields breached munitions, there will be insufficient data available for this AOC to support evaluation of potential presence or transport of MC.

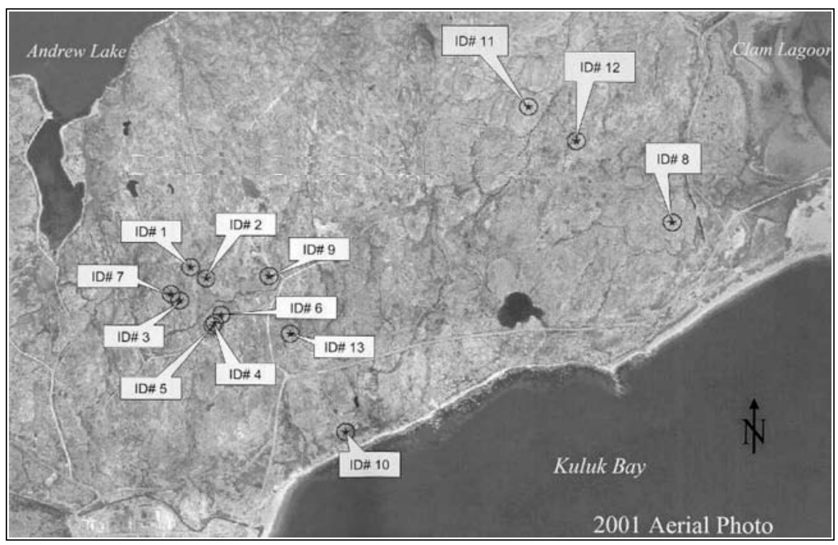
TABLE 4-13
Summary of Previous Investigation Findings for HG-01

			Depth (below ground surface)			
Items Identified	**Number**	**Surface**	**0 to 0.5 feet**	**0.5 to 2 feet**	**2 to 4 feet**	**> 4 feet**
UXO	3	1	1	1	0	0
DMM	0	0	0	0	0	0
MPPEH	2	0	0	2	0	0
MD	22	7	14	1	0	0
Other	122	37	55	28	2	0
Items found:*						
UXO	40-mm grenade M441 (2) 60-mm mortar HE – unfuzed					
MPPEH	CAD (2)					

*Information in this table is provided to identify the type and depths of ordnance recovered only. It is not intended to be a formal inventory.

4.3.7 JM-01 J.M. Candidate Chemical Weapons Disposal Area

This AOC was thought to be located in the Lake Jean area, just west of Combat Range 8. Thirteen sites were evaluated, and none was judged to be the actual location. The site was described by a WWII veteran ("J.M.") as a small, rectangular area enclosed by a barbed-wire fence that was used for a one-time chemical weapons disposal via earth-tamped detonation. Relevant data and information for this AOC are summarized in Table 4-14.



JM-01 Area & Candidate Site Locations

TABLE 4-14
Summary of JM-01 CSM and Characterization Parameters

Total AOC Area:	**N/A; site not located** **Accessible AOC Area:** **N/A; site not located**
Access	N/A; site not located.
Terrain	The general area has diverse terrain. The center of the area is a relatively flat, meadow-like area cut by meandering streams that form deep, winding ravines. On three sides (north, east, and south) of this area, the terrain rises in a series of ridges and ravines. To the west, the terrain falls steeply toward Andrew Lake.
Vegetation	The general area is predominantly tall tundra grass. There are some areas near the hilltops where heaths and mosses are plentiful.
Hydrology/Surface Water	N/A; site not located.
Geology/Hydrogeology	N/A; site not located.
Initial AOC Type	No direct fit in AOC types; alleged CWM disposal site.

TABLE 4-14
Summary of JM-01 CSM and Characterization Parameters

Adjusted AOC Type	N/A; site not located.
Target Munitions	105-mm projectiles filled with mustard gas.
Unique Features	Items buried at ~14 feet before disposal by earth-tamped detonation.
Potential Transport Mechanisms	N/A; site not located.
Sensitive Eco Receptors	N/A; site not located.
Approved Level 2 Methodology (2000)	Disposal Area approach modified to ensure safety with CWM.
Previous MEC Investigation	An extensive search was conducted to locate JM-01 based on an interview with a WWII veteran. The Navy brought the veteran (J.M.) to Adak in an effort to locate the site of the alleged disposal. J.M. identified areas east of Lake Jean that he believed were the sites of a storage bunker and the alleged disposal site. Field staff searched the potential disposal area with a Vallon metal detector and noted positive hits for fallen fenceposts and remnants of a coal-burning camp stove. The Project Team was unconvinced that the location identified by J.M. was correct, and the Navy was tasked to find other candidate sites for reconnaissance. A search for possible disposal sites was conducted using 2001 low-altitude aerial photos, archive aerial photos, and archive maps. Thirteen candidate sites were selected for possible site reconnaissance. Subsequent to the Navy's search, the U.S. Army Corps of Engineers Topographic Engineering Center performed a historical aerial photo analysis and evaluated the candidate sites. The analysis did not confirm any of the candidate sites and did not suggest any other likely locations for this disposal activity.
Previous MC Investigation	N/A.
Applicability of Previous Work	N/A.
Data Gaps	No data gaps can be identified because this AOC has not been located. The Project Team has approved this site for NOFA.

4.3.8 LJ-02A Lake Jean Disposal Area

This AOC is located just south of Lake Jean within the Lake Jean Ammunition Complex. It is contained wholly within AOPC LJ-02 (also called the Western Dump Area). This AOC was originally part of LJ-02 until potential evidence of buried items was found during the search for JM-01 in this area (see Section 4.3.7), necessitating the creation of a new AOC. Relevant data and information for this AOC are summarized in Table 4-15.

TABLE 4-15
Summary of LJ-02A CSM and Characterization Parameters

Total AOC Area:	**0.4 acre**	**Accessible AOC Area:**	**0.4 acre**
Access	Direct via rutted dirt road around the perimeter of LJ-02.		
Terrain	Generally undulating and hummocky.		
Vegetation	Lowland tundra species ranging from 12 to 24 inches in height.		
Hydrology/Surface Water	No known runoff channels or surface water.		
Geology/Hydrogeology	Given that the AOC is approximately 16 to 24 meters (60 to 80 feet) above the Lake Jean shoreline, groundwater is expected to be relatively deep.		
Initial AOC Type	Storage Magazine (formerly part of LJ-02).		
Adjusted AOC Type	Disposal Area.		

TABLE 4-15
Summary of LJ-02A CSM and Characterization Parameters

Target Munitions	None known or found.
Unique Features	Slumping or scarring thought to mark potential burial trenches.
Transport Mechanisms	Intrusive human activity.
Sensitive Eco Receptors	Lake Jean (an embayment of Andrew Lake).
Approved Level 2 Methodology (2000)	Disposal Area approach.
Previous MEC Investigation	Ribbon-walk geophysical survey covering one transect through the site when it was part of LJ-02. Follow-on EM-31 geophysical survey when LJ-02A was created as a result of field observation (potential trench locations) made during the search for JM-01 (see Section 4.3.7). While no anomalies indicative of trenches were visible in the data, three point source anomalies were identified. All three of these targets were intrusively investigated to a maximum depth of 4 feet and were found to be non-munitions-related metal debris at depths between 0 and 1 foot below ground surface.
Previous MC Investigation	None.
Applicability of Previous Work	Previous work met the requirements for reconnaissance and site investigation in a potential disposal area. No characterization required based on initial findings.
Data Gaps	No data gaps identified for this AOC. The Project Team has approved this site for NOFA.

4.3.9 MAG-01 World War II Magazine

MAG-01 is located at the eastern end of the Andrew Lake seawall along the north-central shoreline of Adak Island. The area is a small rectangle that is located at the base of a cliff that rises to meet SA93-01 to the east. To the north, west, and south, MAG-01 is bordered by property lying outside of OU B-2. The elevation in MAG-01 ranges from 6 to 12 meters (20 to 40 feet) asl in the accessible portion of the site. It rises rapidly to elevations above 79.2 meters (260 feet) asl in the eastern portion of the site. Relevant data and information for this AOC are summarized in Table 4-16.

MAG-01, Looking North

TABLE 4-16
Summary of MAG-01 CSM and Characterization Parameters

Total AOC Area:	**12.3 acres**	**Accessible AOC Area:**	**8 acres, remainder inaccessible due to steep slopes and standing water**

Access	Direct via unimproved road originating on the east side of Andrew Lake near the Recreation Center. There is a locked steel gate on this roadway just north of the Recreation Center to deter public access.
Terrain	Relatively flat in the western portion of the site and very steep (cliff-like) in the eastern portion. This AOC is separated from SA93-01 by a tall cliff.
Vegetation	Moderately thick beach grass ranging in height from 8 to 12 inches in the lower areas, with little vegetation in the steeper areas.
Hydrology/Surface Water	A small lake or pond, which may be man-made, is located in the central portion.
Geology/Hydrogeology	Given the AOC’s proximity to Andrew Lake and Andrew Bay and its similar elevation, groundwater is expected to be shallow.

TABLE 4-16
Summary of MAG-01 CSM and Characterization Parameters

Initial AOC Type	Storage Magazine.
Adjusted AOC Type	No adjustment.
Target Munitions	Potentially 20-mm, 37-mm, 40-mm, and 155-mm based on proximity of gun emplacements.
Unique Features	Steep cliff on east side.
Potential Transport Mechanisms	Intrusive human activity; erosion and land wasting.
Sensitive Ecological Habitats	Potentially Andrew Lake (also Andrew Bay, which is not identified as sensitive).
Approved Level 2 Methodology (2000)	Storage Magazine approach.
Previous MEC Investigation	No investigation to date. Munitions use in nearby areas may provide an indication of the types of items potentially present. Two gun emplacements were located near the magazine and two more were located west of the site on the seawall. The magazine may have been used to store ammunition for these gun emplacements. During 2001, the former gun emplacement just north of this AOC was evaluated by detector-aided visual inspection. Packing materials, including M-50/M-54 end caps and pieces of burned Thermite residue, were found. It is not known whether this material is related to the former magazine.
Previous MC Investigation	None.
Applicability of Previous Work	No work conducted in area.
Data Gaps	No MEC data are available for this AOC with which to evaluate the presence/absence of MPPEH, verify the boundaries, or perform hazard analysis as appropriate. No visual observations have been made regarding erosion features that might indicate potential for transport of MEC out of MAG-01.

4.3.10 MI-01 Andrew Lake Rocket Disposal Area

MI-01 is located along the southern side of the mortar impact valley in the Range Complex at Andrew Lake (west of Andrew Lake). It is bordered by MI-02 (the Andrew Lake 40 mm Impact Area) immediately to the west and OB/OD-01 (the Andrew Lake Disposal Range) to the east, and is otherwise surrounded by MI-03 (the Andrew Lake Mortar Impact Area). Elevation in the AOC ranges from 48 to 55 meters (160 to 180 feet) asl. Relevant data and information for this AOC are summarized in Tables 4-17 and 4-18.

TABLE 4-17
Summary of MI-01 CSM and Characterization Parameters

Total AOC Area:	**0.7 acre** **Accessible AOC Area: 0.7 acre**
Access	Indirect via gravel range entry road that terminates at OB/OD-01, which branches from the main access road along the western side of Andrew Lake. This main road is gated (locked steel gate) near the south end of the lake to deter general access. A locked cable barrier also deters access to the range entry road.
Terrain	Slopes gently to the north toward the floor of the mortar impact valley.
Vegetation	Dominant vegetation is a mixture of grasses and lowland tundra species ranging in height from 12 to 24 inches.
Hydrology/Surface Water	No known runoff channels or surface water.
Geology/Hydrogeology	Valley floor is composed of a silty, gravelly, sand, alluvial/colluvial, and/or outwash material overlying andesitic basalt bedrock or consolidated ash tuff. Based on the elevation and proximity to stream channels, groundwater is anticipated to be shallow in lowland areas.

TABLE 4-17
Summary of MI-01 CSM and Characterization Parameters

Initial AOC Type	Target/Impact Area.
Adjusted AOC Type	Disposal Area.
Target Munitions	Primarily 2.36- and 3.5-inch practice rockets.
Unique Features	N/A.
Potential Transport Mechanisms	Intrusive human activities.
Sensitive Ecological Habitats	Andrew Lake and associated fish-bearing streams.
Approved Level 2 Methodology (2000)	Disposal Area approach using multiple 30-m grids.
Previous MEC Investigation	Geophysical survey of approximately 0.1 mile of transect (ribbon walk); intrusive investigation of five targets (33% of those identified) to a maximum depth of 4 feet.
Previous MC Investigation	None.
Applicability of Previous Work	Survey does not fulfill requirements for survey using a 30-m grid with 100% mapping and investigation to bound and characterize a potential disposal area.
Data Gaps	Insufficient MEC data are available to characterize and bound the AOC, and to confirm the AOC type. No data are available for this AOC to support evaluation of potential presence or transport of MC.

TABLE 4-18
Summary of Previous MEC Investigation Findings for MI-01

			Depth (below ground surface)			
Items Identified	**Number**	**Surface**	**0 to 0.5 feet**	**0.5 to 2 feet**	**2 to 4 feet**	**> 4 feet**
UXO	2	0	0	2	0	0
DMM	0	0	0	0	0	0
MPPEH	7	0	7	0	0	0
MD	10	0	6	4	0	0
Other	7	0	4	3	0	0
Items found:*						
UXO	60-mm mortar body (no fuze) Rifle grenade, WP, M19					
MPPEH	2.36-inch rocket motors (6) 3.5-inch rocket motor					

*Information in this table is provided to identify the type and depths of ordnance recovered only. It is not intended to be a formal inventory.

4.3.11 MI-02 Andrew Lake 40 mm Impact Area

MI-02 is located along the southern side of the mortar impact valley in the Range Complex at Andrew Lake (west of Andrew Lake). It is bordered by MI-01 (the Andrew Lake Rocket Disposal Area) to the east and is otherwise surrounded by MI-03 (the Andrew Lake Mortar Impact Area). The elevation in this AOC ranges from about 49 to 104 meters (160 to 340 feet) asl. Relevant data and information for this AOC are summarized in Tables 4-19 and 4-20.

Looking West into MI-02 from OB/OD-01

TABLE 4-19
Summary of MI-02 CSM and Characterization Parameters

Total AOC Area:	**19 acres** **Accessible AOC Area:** **17 acres, remainder inaccessible due to steep slopes**
Access	Indirect via gravel range entry road that terminates at OB/OD-01, which branches from the main access road along the western side of Andrew Lake. This main road is gated (locked steel gate) near the south end of the lake to deter general access. A locked cable barrier also deters access to the range entry road.
Terrain	Relatively flat, rising moderately to the west toward Mt. Moffett. The area is somewhat flatter in the eastern portion closer to Andrew Lake. The area is bordered on the south by steep terrain that becomes inaccessible near the top of the ridge delineating the southern boundary of MI-02 and the Range Complex at Andrew Lake. Steep terrain also forms the northern boundary of this AOC to the west.
Vegetation	Grassy with lowland tundra species ranging in height from 12 to 24 inches.
Hydrology/Surface Water	Possible intermittent standing water in the eastern portion (i.e., lowland area) due to shallow groundwater.
Geology/Hydrogeology	Valley floor is composed of a silty, gravelly, sand, alluvial/colluvial, and/or outwash material overlying andesitic basalt bedrock or consolidated ash tuff. Groundwater in upper portions of this AOC is anticipated to be relatively deep compared with shallow depths expected along the valley floor.
Initial AOC Type	Target/Impact Area.
Adjusted AOC Type	Target/Impact Area.
Target Munitions	Primarily 40-mm projectiles, potential for 2.36-inch rockets.
Unique Features	May be marshy in some areas.
Transport Mechanisms	Human activities.
Sensitive Ecological Habitats	Andrew Lake and associated fish-bearing streams.
Approved Level 2 Methodology (2000)	Target/Impact Area approach using transect spacing for 40-mm projectiles.
Previous MEC Investigation	Geophysical survey of approximately 4.5 miles of transect (ribbon walk); intrusive investigation of 78 targets (75% of those identified) to maximum depth of 4 feet.
Previous MC Investigation	None.
Applicability of Previous Work	Survey did not completely fulfill requirements for survey using 25-m spacing as required for a 40-mm impact area; expansion patterns were not conducted.
Data Gaps	Insufficient MEC data are available to characterize and bound the AOC, and to confirm the AOC type.
	No data are available for this AOC to support evaluation of potential presence or transport of MC.
	No visual observations have been made regarding potential erosion features that might indicate potential for transport of MEC from the AOC.

TABLE 4-20
Summary of Previous Investigation Findings for MI-02

			Depth (below ground surface)			
Items Identified	**Number**	**Surface**	**0 to 0.5 feet**	**0.5 to 2 feet**	**2 to 4 feet**	**> 4 feet**
UXO	14	1	8	5	0	0
DMM	0	0	0	0	0	0
MPPEH	5	0	3	1	1	0
MD	37	1	24	12		
Other	14	4	4	6	0	0

Items found:*

UXO	2.36-inch rocket, AT, armed 40-mm projectiles, variety of types and conditions (13)
MPPEH	81-mm fragment and 60-mm fins and M52 PD nose fuze 81-mm tail boom and fuze parts 40-mm projectile HET – fuze component missing, HE exposed 81-mm illumination (body and fuze only) w/M84 PTT fuze Fuze M557 PD (component part) projectile fuze

*Information in this table is provided to identify the type and depths of ordnance recovered only. It is not intended to be a formal inventory.

4.3.12 MI-03 Andrew Lake Mortar Impact Area

MI-03 consists of a steep valley draining west to east from the flanks of Mt. Moffett toward Andrew Lake. It is bordered by OU B-1 (MM-11 and various components of MM-10) to the west, south, and north. Three OU B-2 AOCs border MI-03 to the east: OB/OD-01 (the Andrew Lake Disposal Range), RR-01 (the Andrew Lake Hand Grenade/40 mm Impact Area), and RR-02 (the Andrew Lake Mortar Impact Area). MI-01 (the Andrew Lake Rocket Disposal Area) and MI-02 (the Andrew Lake 40 mm Impact Area) are located wholly within this AOC. The elevation in MI-03 ranges from about 40.1 meters (130 feet) asl at the eastern edge of this AOC to about 280 meters (920 feet) asl along the western edge of this AOC on the flanks of Mt. Moffett. Relevant data and information for this AOC are summarized in Tables 4-21, 4-22, and 4-23.

Looking West into MI-03 from OB/OD-01

TABLE 4-21
Summary of MI-03 CSM and Characterization Parameters

Total AOC Area:	**425 acres**	**Accessible AOC Area:**	**156 acres, remainder inaccessible due to steep slopes, ravines, and water**

Access	Indirect via gravel range entry road that terminates at OB/OD-01, which branches from the main access road along the western side of Andrew Lake. This main road is gated (locked steel gate) near the south end of the lake to deter general access. A locked cable barrier also deters access to the range entry road.
Terrain	Ranges from being relatively low and flat in the eastern portion nearest the OB/OD area, to steep and inaccessible at the western end and along the southern border. There is a steep ridgeline near the northern side of the AOC with a relatively flat top. The top of this ridge is shared with RR-02.
Vegetation	Grassy in east with lowland tundra species ranging in height from 12 to 24 inches. This gives way to upland species (mixed grasses, heaths, and mosses) of shorter stature in the west.
Hydrology/Surface Water	Runoff channels or streams that run easterly to Moffett Creek, which is partially located within this AOC. Groundwater is anticipated to be shallow in the lowland areas, which provides the potential for groundwater seeps. Small ponds or lakes at two locations.
Geology/Hydrogeology	Valley floor is composed of a silty, gravelly, sand, alluvial/colluvial, and/or outwash material overlying andesitic basalt bedrock or consolidated ash tuff. Groundwater in upper portions of AOC is anticipated to be relatively deep compared with shallow depths expected along the valley floor.
Initial AOC Type	Target/Impact Area.
Adjusted AOC Type	Target/Impact Area.
Target Munitions	Mortars, 40-mm projectiles, rockets, and rifle grenades.
Unique Features	Moffett Creek and runoff channels.
Potential Transport Mechanisms	Human activities; potential overland transport in runoff channels and erosion caused by runoff or slumping of steep slopes.
Sensitive Ecological Habitats	Andrew Lake and associated fish-bearing streams.
Approved Level 2 Methodology (2000)	Target/Impact Area approach using transect spacing for 40-mm projectiles.
Previous MEC Investigation	Geophysical survey of approximately 16.7 miles of transect (ribbon walk); intrusive investigation of 220 targets (55% of those identified) to a maximum depth of 4 feet.
Previous MC Investigation	One sediment and one surface water sample collected.
Applicability of Previous Work	Survey does not completely fulfill requirements for survey using 25-m spacing as required for a 40-mm impact area; expansion patterns were not conducted. Credit should be applied for investigation completed in areas.
Data Gaps	Insufficient MEC data are available to characterize and bound the AOC, and to confirm the AOC type. Insufficient data are available for this AOC to support evaluation of potential presence or transport of MC. No visual observations have been made regarding potential erosion features that might indicate potential for transport of MEC from the AOC.

TABLE 4-22
Summary of Previous Investigation Findings for MI-03

Ordnance-Related Items	Number	Surface	Depth (below ground surface)			
			0 to 0.5 feet	0.5 to 2 feet	2 to 4 feet	> 4 feet
UXO	5	1	3	1	0	0
DMM	2	0	2	0	0	0
MPPEH	8	0	4	4	0	0
MD	90	8	59	23	0	0
Other	75	7	64	4	0	0
Items found:*						
DMM	2.36-inch rockets, practice, not fired (2)					
UXO	40-mm projectile, HE, fuzed, armed 40-mm projectile AP Rifle grenade, WP 3.5-inch rocket WP, fired 81-mm mortar (live) w/nose fuze and tail boom					
MPPEH	Fuze M557 PD (parts) Zuni rocket motor (5) 2.36-inch rocket motor section and tail 3.5-inch rocket motor Trip flare 2.36-inch rocket, practice M7A1 40-mm projectile TPT (2)					

*Information in this table is provided to identify the type and depths of ordnance recovered only. It is not intended to be a formal inventory.

TABLE 4-23
Summary of Previous MC Sampling Results for MI-03

Media	Number of Samples (year)	Analyzed Constituents	Identified COPCs*
Sediment; Surface water	1 (1992); 1 (1992)	MC, inorganics, VOCs, SVOCs, total cyanide	None

*Analytical results were compared with ecological risk-based screening concentrations (RBSCs) for Adak and background values to identify COPCs as part of a screening risk assessment conducted in 1996.

4.3.13 MM-10D Mt. Moffett Impact Area Lone 81 mm Mortar

This AOC is a small, square site on the eastern flanks of Mt. Moffett, where a lone, partial 81-mm mortar (frag) was found. It is located adjacent to the southern boundary of MI-03 (the Andrew Lake Mortar Impact Area) directly south of the western edge of MI-02 (the Andrew Lake 40 mm Impact Area). The elevation of this AOC is approximately 213 meters (700 feet) asl. Relevant data and information for this AOC are summarized in Tables 4-24 and 4-25.

Eroded Patches in MM-10D

TABLE 4-24
Summary of MM-10D CSM and Characterization Parameters

Total AOC Area:	**0.2 acre** **Accessible AOC Area: 0.2 acre**
Access	Access is difficult given the steep embankment to the north, which separates AOC from the mortar impact valley in the Range Complex at Andrew Lake.
Terrain	Slopes gently to the east; however, just north of the site the terrain falls very steeply into the Range Complex at Andrew Lake.
Vegetation	Sparse and consists of short tundra grasses, lichens, mosses, and alpine flowers.
Hydrology/Surface Water	No known runoff channels or surface water.
Geology/Hydrogeology	Groundwater is anticipated to be quite deep based on the terrain and elevation.
Initial AOC Type	Target/Impact Area.
Adjusted AOC Type	No adjustment.
Target Munitions	81-mm mortar (lone piece of frag found) (see Table 4-26).
Unique Features	Barren, eroded patches in the vegetation.
Potential Transport Mechanisms	Human activities, potential erosion, and overland transport.
Sensitive Eco Receptors	None.
Approved Level 2 Methodology (2000)	Target/Impact Area approach using transect spacing for 81-mm mortars.
Previous MEC Investigation	Geophysical survey of 0.037 mile of ribbon walk to obtain one-dimensional geophysical data along a loop through the area. Follow-up with an additional 0.24 mile of geophysical mapping to perform the then-approved expansion-pattern investigation of the OE Scrap item found in 1999.
Previous MC Investigation	None.
Applicability of Previous Work	Level 2 methodology requirements fulfilled.
Data Gaps	No data gaps identified for this AOC. The Project Team has approved this site for NOFA.

TABLE 4-25
Summary of Previous Investigation Findings for MM-10D

Ordnance-Related Items	Number	Surface	Depth Range (bgs) 0 to 0.5 feet	0.5 to 2 feet	2 to 4 feet	> 4 feet
UXO	0	0	0	0	0	0
DMM	0	0	0	0	0	0
MPPEH	1	1	0	0	0	0
MD	0	0	0	0	0	0
Other	0	0	0	0	0	0
Items found:*						
MPPEH	partial 81-mm mortar (frag)					

*Information in this table is provided to identify the type and depths of ordnance recovered only. It is not intended to be a formal inventory.

4.3.14 OB/OD-01 Andrew Lake Disposal Area

OB/OD-01 is a circular area with a radius of 182 meters (600 feet). The boundary encompasses visible historical demolition craters and an ample buffer zone around the craters to account for kick-outs during disposal operations. This AOC is located at the terminus of the general Range Complex at Andrew Lake access road. It is bordered by RR-02 (the Andrew Lake Mortar Impact Area) to the northwest; RR-01 (the Andrew Lake Hand Grenade/40 mm Impact Area) to the northeast, east, and southeast; and MI-03 (the Andrew Lake Mortar Impact Area) to the south and west. The elevation in this AOC ranges from about 33 to 40 meters (110 to 130 feet) asl. Portions of the area are inaccessible because of the presence of Moffett Creek and water-filled craters. Relevant data and information for this AOC are summarized in Tables 4-26, 4-27, and 4-28.

OB/OD-01 Looking Northwest over Former Disposal Crater

OB/OD-01 Looking Southwest Along the Ridge Bordering the Range on the South Side

TABLE 4-26
Summary of OB/OD-01 CSM and Characterization Parameters

Total AOC Area:	18 acres	Accessible AOC Area:	16.8 acres, remainder inaccessible due to standing water and creek
Access	Indirect via gravel range entry road, which branches from the main access road along the west side of Andrew Lake. This main road is gated (locked steel gate) near the south end of the lake to deter general access. A locked cable barrier also deters access to the range entry road.		
Terrain	Relatively flat, but hummocky in some locations and marshy in others. There are several craters in this area resulting from previous disposal events.		
Vegetation	Generally covered in knee-high, grassy tundra; however, there are relatively barren areas surrounding some of the disposal craters.		
Hydrology/Surface Water	Moffett Creek runs from west to northeast through the northwestern portion. Standing water has been observed in the disposal craters.		
Geology/Hydrogeology	Valley floor is composed of a silty, gravelly, sand, alluvial/colluvial, and/or outwash material overlying andesitic basalt bedrock or consolidated ash tuff. The groundwater is shallow, as evidenced by standing water in the disposal craters. Groundwater is in hydraulic communication with the creek (i.e., there is interconnection between the creek and the groundwater aquifer in this area).		
Initial AOC Type	OB/OD Area.		
Adjusted AOC Type	No adjustment.		
Target Munitions	Various munitions and components such as fuzes.		
Unique Features	Craters; Moffett Creek.		
Transport Mechanisms	Intrusive human activities (notably detonation of munitions); percolation of run-off into the groundwater; overland transport by Moffett Creek, which runs through the area.		
Sensitive Ecological Habitats	Andrew Lake and associated fish-bearing streams.		
Approved Level 2 Methodology (2000)	OB/OD approach.		
Previous MEC Investigation	100% geophysical survey of the AOC; intrusive investigation of 341 targets (38% of total) to a maximum depth of 4 feet.		
Previous MC Investigation	Ten surface soil samples collected from cleared portions of the OB/OD area.		
Applicability of Previous Work	100% survey satisfies requirements for OB/OD. 100% excavation of anomalies was not completed; however, a large number of anomalies were investigated and sufficient MEC data are available for FS or other future analyses.		
Data Gaps	Insufficient MC data are available to evaluate potential presence or transport of MC. Insufficient geotechnical data are available to determine the suitability of soil screening as a potential remedial option for this AOC.		

TABLE 4-27
Summary of Previous MEC Investigation Findings for OB/OD-01

Items Identified	Total Number	Surface	Depth (below ground surface) 0 to 0.5 feet	0.5 to 2 feet	2 to 4 feet	> 4 feet
UXO	2	0	2	0	0	0
DMM	6	2	31	1	0	0
MPPEH	21	3	12	6	0	0
MD	79	4	65	10	0	0
Other	226	19	174	31	2	0

Items found:*

UXO	M26 HE Grenade M34 WP Grenade
DMM	7.62-mm round (live) M52A1 M34 WP grenade in damaged shipping can VT fuze Grenade (2)
MPPEH	CADs (41, multiple finds at several locations, records indicate area is saturated w/ CADs) Sonar buoy CADs (4) 81-mm fragment (low ordered) Suspect empty bomb fuze AN/M 219 (2) M103 fuze piece Fuze MK25 sea marker Signal flare M52A1

*Information in this table is provided to identify the type and depths of ordnance recovered only. It is not intended to be a formal inventory.

TABLE 4-28
Summary of Previous MC Sampling Results for OB/OD-01

Media	Number of Samples (year)	Analyzed Constituents[a]	Identified COPCs[b,c]
Soil (0–1 feet)	10 (1993)	MC, TPH, inorganics, VOCs, SVOCs, total cyanide	4 Ordnance (2,4-dinitrotoluene, 2,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, RDX); 3 inorganic (copper, lead, zinc); 4 SVOCs (benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, indeno[1,2,3-cd]pyrene).

[a]Not all samples analyzed for full suite of constituents listed.

[b]Analytical results were compared with ecological and human RBSCs and background values to identify COPCs as part of a 1996 screening risk assessment.

[c]Other constituents, such as hexachlorobenzene and arsenic, exceeded the screening levels but were not considered a significant concern.

Note:

Results are from a 1996 screening-level assessment. A subsequent, detailed, 1997 risk assessment indicated that for human health, site soils posed no significant risk to hypothetical residential, recreational, or occupational use, and for ecological health, a small area beneath the burn pan was problematic. This burn pan is no longer present.

4.3.15 RG-01 Andrew Lake 40 mm Rifle Grenade Range

This AOC is located on a hillside northwest of the HG-01 (the Andrew Lake Hand Grenade Range). The area is trapezoidal in shape, narrowing from the target line near the base of a hill to the crown of the hill. RG-01 is bordered by RR-01 (the Andrew Lake Hand Grenade/40 mm Impact Area) to the east and southeast, and is otherwise surrounded by RR-02 (the Andrew Lake Mortar Impact Area). The elevation in this AOC ranges from about 34 meters (110 feet) asl near the target line to about 125 meters (410 feet) asl at the top of the hill behind the targets.

An NTCRA was conducted at RG-01 in 2006 and 2008. Relevant data and information for this AOC are summarized in Tables 4-29, 4-30, and 4-31.

Looking West Toward RG-01 from Former Rifle Range in RR-01

TABLE 4-29
Summary of RG-01 CSM and Characterization Parameters

Total AOC Area:	16 acres
Accessible AOC Area:	**12 acres, remainder inaccessible due to steep slopes**
Access	Direct via gravel road running from the range entry road up to the firing line area. This road connects ultimately to the main access road for the general range area on the west side of Andrew Lake. This main road is gated (locked steel gate) near the south end of the lake to deter general access. A locked cable barrier also deters access to the range entry road.
Terrain	Steep and largely inaccessible in the western portion of the AOC.
Vegetation	Tundra grass up to 18 inches tall with a very thick rootmat near the firing line. Steeper areas generally consist of shorter grasses interspersed with alpine flowers and some moss.
Hydrology/Surface Water	Possible intermittent standing water in the southeastern portion (i.e., lowland area) because of shallow groundwater.
Geology/Hydrogeology	Groundwater is shallow in the lowland areas in the southeastern portion.
Initial AOC Type	Target/Impact Area.
Adjusted AOC Type	No adjustment.
Target Munitions	40-mm grenades, 60 and 81-mm mortars
Unique Features	Depression in hillside left by former targets.
Potential Transport Mechanisms	Intrusive human activities.
Sensitive Eco Receptors	Andrew Lake and associated fish-bearing streams.
Approved Level 2 Methodology (2000)	Target/Impact Area approach. No specific transect spacing approved for 40-mm grenades.
Previous MEC Investigation	NTCRA consisting of 100% clearance using mag & dig techniques, which began in 2006. NTCRA completed in 2008.
Previous MC Investigation	None.
Applicability of Previous Work	Clearance will meet the requirements for hazard reduction in this AOC.
Data Gaps	No data gaps identified for this AOC.

TABLE 4-30
Summary of 2006 MEC Removal

Items Identified	Total Number	Surface	Depth (below ground surface)			
			0 to 1 feet	1 to 2 feet	2 to 4 feet	> 4 feet
UXO[a]	96	3	93	0	0	0
MPPEH[b]	49	3	46	0	0	0

[a]List of UXO finds: M433 40-mm high explosive dual purpose (HEDP) grenades, M651 40-mm riot tear gas, 60-mm mortar, 81-mm mortar, 40-mm HE, and CAD.

[b]List of MPPEH finds: M651 40-mm riot tear gas, fuze bomb, 37-mm armor-piercing tracer (APT), 40-mm antiaircraft (AA), flare candle.

TABLE 4-31
Summary of 2008 MEC Removal

Items Identified	Total Number	Surface	Depth (below ground surface)			
			0 to 1 feet	1 to 2 feet	2 to 4 feet	> 4 feet
UXO[a]	71	2	57	11	1	0
MPPEH[b]	4	3	1	0	0	0
Breached Munitions (MC)[c]	2	1	1	0	0	0

[a]List of UXO finds: M433 40-mm HEDP grenades, M651 40-mm riot tear gas, M397 40-mm HE grenades, M716 40-mm Smoke grenades, and M28 3.5 inch HEAT rocket.

[b]List of MPPEH finds: M48 Series fuze, JAU-22b initiator (CAD), and MK 219-4 bomb fuze.

[c]List of Breached Munitions finds: MK2 40-mm projectile, high explosive w/tracer self destruct (HE-T/SD); M397A1 40-mm, HE (half) ball assembly.

4.3.16 RR-01 Andrew Lake Hand Grenade/40 mm Impact Area

RR-01 is located in the southern central portion of the Range Complex at Andrew Lake. It is bordered by RR-02 (the Andrew Lake Mortar Impact Area) to the north; OU B-1 to the south; RR-04 (the Andrew Lake Range Remainder) to the east; and OB/OD-01 (the Andrew Lake Disposal Area), RG-01 (the Andrew Lake 40 mm Rifle Grenade Range), and MI-03 (the Andrew Lake Mortar Impact Area) to the west. HG-01 (the Andrew Lake Hand Grenade Range) is located wholly within this AOC. The elevation in this AOC ranges from about 15 to 152 meters (50 to 500 feet) asl. Relevant data and information for this AOC are summarized in Tables 4-32, 4-33, and 4-34.

View Looking Southwest Along the Northwestern Edge of the Former Rifle Range in RR-01

TABLE 4-32
Summary of RR-01 CSM and Characterization Parameters

Total AOC Area:	182 acres Accessible AOC Area: 132 acres, remainder inaccessible due to steep slopes
Access	Direct via range entry road, which branches from the main access road along the west side of Andrew Lake. This main road is gated (locked steel gate) near the south end of the lake to deter general access. A locked cable barrier also deters access to the range entry road.
Terrain	Generally flat in northern portion, but can be uneven and marshy. The steep slopes to the south make the southern third of the AOC largely inaccessible.
Vegetation	Predominantly dense, lush tundra grass in lowland accessible portions.
Hydrology Surface Water	Moffett Creek runs from west to northeast through the northern portion of this AOC. Lowland areas bordering this creek are often saturated with pooled water at certain times of the year. Groundwater is in hydraulic communication with the creek.
Geology/Hydrogeology	Valley floor is composed of a silty, gravelly, sand, alluvial/colluvial, and/or outwash material overlying andesitic basalt bedrock or consolidated ash tuff. The groundwater is anticipated to be shallow in lowland areas.
Initial AOC Type	No AOC Type; buffer for range areas.
Adjusted AOC Type	Target/Impact Area.
Target Munitions	37-mm projectiles; 40-mm HE projectiles; 2.36-inch rockets.
Unique Features	Moffett Creek; some steep slopes. Historically, a known distance rifle range was present within this AOC.
Potential Transport Mechanisms	Intrusive human activities; erosion; overland transport by Moffett Creek, which runs through the area.
Sensitive Ecological Habitats	Andrew Lake and associated fish-bearing streams.
Approved Level 2 Methodology (2000)	Target/Impact Area approach using transect spacing for 37-mm projectiles.
Previous MEC Investigation	Geophysical survey of approximately 17.4 miles of transect (ribbon walk); intrusive investigation of 420 targets (67% of those identified) to a maximum depth of 4 feet.
Previous MC Investigation	Two sediment and one surface water samples collected from Moffett Creek in 1993. In 1995, two additional sediment samples were collected from the same stretch of Moffett Creek.
Applicability of Previous Work	Survey does not completely fulfill requirements for survey using 20-m spacing as required for a 37-mm impact area; expansion patterns were not conducted; 30-m grids were not placed in areas indicated to have different ordnance-related item densities. Credit should be applied for investigation completed.
Data Gaps	Insufficient MEC data are available to characterize and bound the AOC, and to confirm the AOC type. If breached munitions are found during the RI, insufficient data will be available for this AOC to support evaluation of potential presence or transport of MC. No visual observations have been made regarding potential erosion features that might indicate potential for transport of MEC from this AOC.

TABLE 4-33
Summary of Previous MEC Investigation Findings for RR-01

Ordnance-Related Items	Total Number	Surface	Depth Range (bgs)			
			0 to 0.5 feet	0.5 to 2 feet	2 to 4 feet	> 4 feet
UXO	4	1	3	0	0	0
DMM	7	2	4	1	0	0
MPPEH	12	0	11	1	0	0
MD	101	12	75	14	0	0
Other	181	13	166	1	1	0

Items found:*

DMM	M16 (30) round w/ 5.56-mm ammunition load (5) Numerous bullets AF 7.62 rounds Small arms clips	
UXO	2.36-in rocket motor expended, head intact 2.36-in rocket, nose intact 37-mm projectile w/base fuze (possible M58) in fired condition 40-mm grenade	
MPPEH	MKII hand grenade, without fuze, HE residue Full head of 40-mm practice grenade w/ dye marker (4) Practice grenade for the M67 w/live practice Fuze M228 (M69 practice grenade) Inner projectile of slap-type flare Remnants of signal slap flare	Base of 4-mm practice grenade and M60 fuze igniter 2.36-in rocket, practice 40-mm HE M397, explosive ball separated from grenade body

*Information in this table is provided to identify the type and depths of ordnance recovered only. It is not intended to be a formal inventory.

TABLE 4-34
Summary of Previous MC Sampling Results for RR-01

Media	Number of Samples (year)	Analyzed Constituents[a]	Identified COPCs[b]
Sediment; Surface Water	4 (1993, 1995); 1 (1993)	MC, inorganics, VOCs, SVOCs, total cyanide, PCBs, pesticides	None

[a]Not all samples analyzed for full suite of constituents listed.

[b]Analytical results were compared with ecological RBSCs and background values to identify COPCs as part of a 1996 screening risk assessment.

4.3.17 RR-02 Andrew Lake Mortar Impact Area

This AOC is located along the northern side of the valley containing the Range Complex at Andrew Lake. RR-02 includes a valley running east/west that connects the flank of Mt. Moffett with the lowlands on the western shore of Andrew Lake. This AOC shares a steep ridgeline and plateau area atop the ridge with MI-03 (the Andrew Lake Mortar Impact Area) to the south. RR-02 is bordered by OU B-1 to the north; SA-01 (the Andrew Lake Subcaliber Training Range) and RR-04 (the Andrew Lake Range Remainder) to the east; MI-03 (the Andrew Lake Mortar Impact Area) to the west; and RG-01 (the Andrew Lake 40 mm Rifle Grenade Range), RR-01 (the Andrew Lake Hand Grenade/40 mm Impact Area), and OB/OD-01 (the Andrew Lake Disposal Area) to the south. Elevations in this AOC range from about 12 to 238 meters (40 to 780 feet) asl. Relevant data and information for this AOC are summarized in Tables 4-35 and 4-36.

Looking Northwest Toward RR-02 from the Former Rifle Range East of RG-01

TABLE 4-35
Summary of RR-02 CSM and Characterization Parameters

Total AOC Area:	**231 acres** Accessible AOC Area: 120 acres, remainder inaccessible due to steep slopes
Access	Direct access via small dirt road, which branches from the main access road along the west side of Andrew Lake. This main road is gated (locked steel gate) near the south end of the lake to deter general access.
Terrain	Rises from the flatlands near Andrew Lake to a narrow, steep valley bordered by steep hillsides (north, south, and west). An inaccessible ridge runs along the south side of this AOC, which has a relatively flat top.
Vegetation	Grassy with lowland tundra species ranging in height from 12 to 24 inches. There are also scattered areas containing mosses, heaths, and alpine flowers. Vegetation is sparser at higher elevations.
Hydrology/Surface Water	An ephemeral drainage channel cuts across this AOC to SA-01 and ultimately to Andrew Lake.
Geology/Hydrogeology	Valley floor is composed of a silty, gravelly, sand, alluvial/colluvial, and/or outwash material overlying andesitic basalt bedrock or consolidated ash tuff. Groundwater is anticipated to be shallow in lowland areas in the eastern portion. Groundwater is expected to be deep at the higher elevations to the west.
Initial AOC Type	No AOC Type; buffer for range areas.
Adjusted AOC Type	Potential Target/Impact Area per Project Team agreement (based on finding of MPPEH in 1999).
Target Munitions	Not known; only scrap found (40-mm cartridges; 40-mm AP projectiles; 81-mm mortars; 60-mm mortars; and signal flares) [no ordnance found].
Unique Features	Ephemeral drainage channels, marshy areas.
Potential Transport Mechanisms	Intrusive human activities; erosion; overland transport by Moffett Creek, which runs through the area.
Sensitive Ecological Habitats	Andrew Lake and associated fish-bearing streams.
Approved Level 2 Methodology (2000)	Target/Impact Area approach using transect spacing for 40-mm projectiles.
Previous MEC Investigation	Geophysical survey of approximately 7.5 miles of transect (ribbon walk); intrusive investigation of 44 targets (100% of those identified) to a maximum depth of 4 feet.
Previous MC Investigation	None.
Applicability of Previous Work	Survey does not completely fulfill requirements for survey using 25-m spacing as required for a 40-mm impact area; expansion patterns were not conducted.

TABLE 4-35
Summary of RR-02 CSM and Characterization Parameters

Data Gaps	Insufficient MEC data are available to characterize and bound the AOC, and to confirm the AOC type. If breached munitions are found during the RI, insufficient data will be available for this AOC to support evaluation of potential presence or transport of MC. No visual observations have been made regarding potential erosion features that might indicate potential for transport of MEC from the AOC.

TABLE 4-36
Summary of Previous MEC Investigation Findings for RR-02

Ordnance-Related Items	Total Number	Surface	Depth Range (bgs)			
			0 to 0.5 feet	0.5 to 2 feet	2 to 4 feet	> 4 feet
UXO	0	0	0	0	0	0
DMM	0	0	0	0	0	0
MPPEH	0	0	0	0	0	0
MD	68	64	3	1	0	0
Other	27	27	0	0	0	0

4.3.18 RR-03 Andrew Lake Flare Disposal Site

This AOC is a small, square site located near the southeastern boundary of the former Range Complex at Andrew Lake. It is wholly within AOC RR-04 (the Andrew Lake Range Remainder) and was created to allow evaluation of a lone, abandoned, signal flare found in 1999. The elevation in this AOC is about 12 meters (40 feet) asl. Relevant data and information for this AOC are summarized in Tables 4-37 and 4-38.

Signal Flare Found in RR-03

TABLE 4-37
Summary of RR-03 CSM and Characterization Parameters

Total AOC Area:	**0.2 acre**	**Accessible AOC Area:**	**0.2 acre**

Access	Indirect via gravel road that branches from the main access road along the west side of Andrew Lake. This main road is gated (locked steel gate) near the south end of the lake to deter general access. A locked cable barrier also deters access to the range entry road.
Terrain	Relatively flat.
Vegetation	Tall, lush grass ranging in height from 12 to 18 inches.
Hydrology/Surface Water	No standing water features expected; however, standing water was observed during the previous investigations.
Geology/Hydrogeology	Groundwater is anticipated to be relatively shallow based on this AOC's proximity to Andrew Lake.
Initial AOC Type	Range Buffer Zone.

TABLE 4-37
Summary of RR-03 CSM and Characterization Parameters

Adjusted AOC Type	No adjustment.
Target Munitions	2.36-inch rocket and signal flare (Table 4-38).
Unique Features	None noted.
Potential Transport Mechanisms	Intrusive human activities.
Sensitive Eco Receptors	Andrew Lake and associated fish-bearing streams.
Approved Level 2 Methodology (2000)	Disposal Area approach using 30 meter grids.
Previous MEC Investigation	Geophysical survey of approximately 1 mile of ribbon walk; intrusive investigation of 39 targets (100% of those identified) to a maximum depth of 4 feet.
Previous MC Investigation	A soil sample was collected from an area where ordnance was discovered that was breached; no detectable levels of ordnance-related chemicals were found.
Applicability of Previous Work	Level 2 methodology requirements fulfilled.
Data Gaps	No data gaps identified for this AOC. The Project Team has approved this site for NOFA.

TABLE 4-38
Summary of Previous MEC Investigation Findings for RR-03

Ordnance-Related Items	Total Number	Surface	Depth Range (bgs)			
			0 to 0.5 feet	0.5 to 2 feet	2 to 4 feet	> 4 feet
UXO	0	0	0	0	0	0
DMM	2	0	1	0	0	0
MPPEH	0	0	0	0	0	0
MD	0	0	0	0	0	0
Other	66	5	58	3	0	0
Items found:*						
DMM	Possible rocket motor Signal illumination ground white star M18					

*Information in this table is provided to identify the type and depths of ordnance recovered only. It is not intended to be a formal inventory.

4.3.19 RR-04 Andrew Lake Range Remainder

RR-04 encompasses most of the lower valley at the former Range Complex at Andrew Lake. It is bordered by a narrow strip of shoreline along Andrew Lake on the north and northeast; RR-01 (the Andrew Lake Hand Grenade/40 mm Impact Area) to the southwest; SA-01 (the Andrew Lake Subcaliber Training Range) to the northwest;) and RR-02 (the Andrew Lake Mortar Impact Area) to the west; and undesignated portions of Parcel 4 to the south. RR-03 (Andrew Lake Flare Disposal Area) is located wholly within RR-04. The elevation in most of the AOC is 6 to 12 meters (20 to 40 feet) asl. A steep ridge on the south side of this AOC rises to just over 67 meters (220 feet) asl. Relevant data and information for this AOC are summarized in Tables 4-39, 4-40, and 4-41.

Looking East Through RR-04 Toward Andrew Lake

TABLE 4-39
Summary of RR-04 CSM and Characterization Parameters

Total AOC Area:	**253 acres**	**Accessible AOC Area:**	**236 acres, remainder inaccessible due to steep slopes and standing water**
Access	Direct access via the gravel range entry road that runs through this AOC. This road connects ultimately to the main access road on the west side of Andrew Lake, which currently has a locked steel gate near the south end of the lake to deter public access. A locked cable barrier also deters access to the range entry road.		
Terrain	Generally flat, except along the southern side of the Range Complex at Andrew Lake, where a steep hillside forms the southern valley wall.		
Vegetation	Grassy with lowland tundra species ranging in height from 12 to 24 inches. There are also scattered areas containing mosses, heaths, wetland species, and alpine flowers.		
Hydrology/Surface Water	Moffett Creek runs from southwest to northeast through the central portion of this AOC. The lowland areas bordering this creek are often saturated with pooled water or are subject to overland sheet flow at certain times of the year.		
Geology/Hydrogeology	Valley floor is composed of a silty, gravelly, sand, alluvial/colluvial, and/or outwash material overlying andesitic basalt bedrock or consolidated ash tuff. Groundwater is anticipated to be relatively shallow based on this AOC's proximity to Andrew Lake. Groundwater is in hydraulic communication with the creek.		
Initial AOC Type	Range Buffer Zone.		
Adjusted AOC Type	No adjustment.		
Target Munitions	None known.		
Unique Features	Moffett Creek, marshy areas, standing water at some locations at certain times.		
Potential Transport Mechanisms	Intrusive human activities; overland transport in runoff channels; erosion caused by runoff.		
Sensitive Ecological Habitats	Andrew Lake and associated fish-bearing streams.		
Approved Level 2 Methodology (2000)	Buffer area is not an AOC type; no evaluation required in the Level 2 methodology.		
Previous MEC Investigation	Field reconnaissance during the PSEs and geophysical survey of approximately 12 miles of transect (ribbon walk); intrusive investigation of 87 targets (82 percent of those identified) to a maximum depth of 4 feet.		
Previous MC Investigation	In 1993, two sediment and two surface water samples were collected from the mouth of Moffett Creek at the outflow to Andrew Lake just east of the boundary of this AOC.		

TABLE 4-39
Summary of RR-04 CSM and Characterization Parameters

Applicability of Previous Work	No specific methodology for a range buffer area. ADEC has suggested that the Combat Range methodology be applied, requiring mapping of transects spaced at 105 m. Previous work performed meets the requirements for this methodology in most areas. A small amount of investigation will be needed to close data gaps.
Data Gaps	Insufficient MEC data are available to fully characterize and bound the AOC, and to confirm the AOC type. Insufficient data are available for this AOC to support evaluation of potential transport of MC through the AOC via surface water or groundwater to Andrew Lake.

TABLE 4-40
Summary of Previous MEC Investigation Findings for RR-04

			Depth (below ground surface)			
Items Identified	**Total Number**	**Surface**	**0 to 0.5 feet**	**0.5 to 2 feet**	**2 to 4 feet**	**> 4 feet**
UXO	0	0	0	0	0	0
DMM	0	0	0	0	0	0
MPPEH	0	0	0	0	0	0
MD	1	1	0	0	0	0
Other*	72	18	50	5	0	0

*A trash pit containing bottles, cans, and other municipal waste-type items was found. The range of clearance for this pit was 0 to 12 inches, and this find is listed as a surface find in the table.

TABLE 4-41
Summary of Previous MC Investigation Findings for RR-04

Media	Number of Samples (year)	Analyzed Constituents	COPCs*
Sediment; Surface Water	2 (1993); 1 (1993)	MC, inorganics, VOCs, SVOCs, total cyanide	None

*Analytical results were compared with ecological RBSCs and background values to identify COPCs as part of a 1996 screening risk assessment.

4.3.20 SA-01 Subcaliber Training Range

SA-01 is located at the northern edge of the former Range Complex at Andrew Lake (on the west side of Andrew Lake). It is bordered by AOPC SA-02 (the Andrew Lake Pistol Range) to the north, RR-04 (the Andrew Lake Range Remainder) to the east, and RR-02 (the Andrew Lake Mortar Impact Area) to the west and south. Elevation in this AOC ranges from about 12 to 49 meters (40 to 160 feet) asl. Relevant data and information for this AOC are summarized in Tables 4-42 and 4-43.

SA-01, Looking South Toward Andrew Lake

TABLE 4-42
Summary of SA-01 CSM and Characterization Parameters

Total AOC Area:	10.2 acres — Accessible AOC Area: 7 acres, remainder inaccessible due to steep slopes
Access	Access to this AOC is provided directly by the small arms range access road to the north, which branches from the main access road along the west side of Andrew Lake. This main road is gated (locked steel gate) near the south end of the lake to deter general access.
Terrain	Relatively flat in most areas, but slopes upward in the southwestern corner.
Vegetation	Primarily tall, lush grasses ranging in height from 6 to 18 inches.
Hydrology/Surface Water	An ephemeral drainage channel cuts across the abutting RR-02 through this AOC to Andrew Lake.
Geology/Hydrogeology	Valley floor is composed of a silty, gravelly, sand, alluvial/colluvial, and/or outwash material overlying andesitic basalt bedrock or consolidated ash tuff. Groundwater is anticipated to be relatively shallow based on this AOC's proximity to Andrew Lake.
Initial AOC Type	Small Arms Range.
Adjusted AOC Type	No adjustment.
Target Munitions	None known; small cache of .30 caliber AP rounds found (no UXO).
Unique Features	Remnants of target berms.
Potential Transport Mechanisms	Intrusive human activities; overland transport; transport due to erosion and runoff.
Sensitive Ecological Habitats	Andrew Lake and associated fish-bearing streams.
Approved Level 2 Methodology (2000)	None for small arms ranges; method for a disposal area would have been applicable if the area had been designated as such in the PA.
Previous MEC Investigation	Field reconnaissance during the PSEs and incidental encroachment during the 1999 SI.
Previous MC Investigation	None.
Applicability of Previous Work	No investigations performed.
Data Gaps	Insufficient MEC data are available to characterize and bound this AOC, and to confirm the AOC type. No visual observations have been made regarding potential erosion features that might indicate potential for transport of MEC from this AOC.

TABLE 4-43
Summary of Previous Investigation Findings for SA-01

			Depth (below ground surface)			
Items Identified	**Total Number**	**Surface**	**0 to 0.5 feet**	**0.5 to 2 feet**	**2 to 4 feet**	**> 4 feet**
UXO	0	0	0	0	0	0
DMM	0	0	0	0	0	0
MPPEH	0	0	0	0	0	0
MD	1	0	1	0	0	0
Other	3	0	3	0	0	0

4.3.21 SA93-01 Source Area 93 Multiple Impact Area

Geo Team Member Mapping in a Northerly Direction Along the Flanks of the Steep Ridge on the West Side of SA93-01

SA93-01 is located to the northeast of Andrew Lake. Most of the site is on a plateau some 91 to 122 meters (300 to 400 feet) above the lake, but a small strip of this AOC along the southwestern corner abuts the shoreline of the lake. This AOC is bordered by SA93-02 (the Source Area 93 Eastern Impact Area) to the east, areas lying outside Parcel 4 to the north and south, and Andrew Lake to the southwest. It is also bordered by MAG-01 (the Andrew Lake World War II Magazine) to the west, but the two areas are not physically contiguous because of a steep cliff (i.e., MAG-01 is at the base of the cliff). Elevations in the central portion of this AOC range from about 67 to 98 meters (220 to 320 feet) asl. Along the western edge of this AOC, a steep ridge rises to just over 152 meters (500 feet) and then falls very rapidly (cliff) to elevations below 100 feet asl. To the north, a steep ridge rises to over 213 meters (700 feet) on the flanks of a small mountain peak. The CSM and characterization parameters for SA93-01 are listed in Table 4-44. Previous MEC investigation results are summarized in Table 4-45.

TABLE 4-44
Summary of SA93-01 CSM and Characterization Parameters

Total AOC Area:	**263 acres** **Accessible AOC Area:** **188 acres, remainder inaccessible due to steep slopes, ravines, and water**
Access	Indirect via walk from gravel road originating from the east side of Andrew Lake near the Recreation Center. The entire historical impact area in which this AOC resides is currently fenced (4-strand barbed wire), with posted signage to deter public access.
Terrain	On the west side of this AOC, a steep ridge forms a cliff above Andrew Lake. To the east of this ridge, the terrain falls gently toward a deep drainage ravine near the east side of this AOC.
Vegetation	Generally a mixture of grasses, sedges, mosses, and heaths ranging in height from 18 to 30 inches.
Hydrology/Surface Water	Deep ravine at the eastern edge that carries runoff southward toward Andrew Lake. Also, there are areas of standing water or streams in the south-central portion of the AOC.
Geology/Hydrogeology	Groundwater is expected to be deep, given the elevation of this AOC compared with Andrew Lake and Andrew Bay.
Initial AOC Type	Target/Impact Area for mortars.
Adjusted AOC Type	Target/Impact Area for multiple types of ordnance.
Target Munitions	2.36-inchch rockets; 37-mm projectiles; 37-mm HE projectiles; 57-mm HE projectiles; 75-mm HE projectiles; and 81-mm mortars.
Unique Features	Deep ravine on the east; cliff on the west; stream channels or standing water in the central area.
Potential Transport Mechanisms	Human activities; overland transport by streams; transport due to erosion and slumping.
Sensitive Ecological Habitats	Andrew Lake and associated fish-bearing streams.
Approved Level 2 Methodology (2000)	Target/Impact Area approach using transect spacing for 37-mm projectiles.
Previous MEC Investigation	Geophysical survey of approximately 12.5 miles of transect (ribbon walk); intrusive investigation of 181 targets (100%) to a maximum depth of 4 feet.
Previous MC Investigation	None.

TABLE 4-44
Summary of SA93-01 CSM and Characterization Parameters

Applicability of Previous Work	Survey does not completely fulfill requirements for survey using 20-m spacing as required for a 37-mm impact area; expansion patterns were not conducted; credit should be applied for investigation completed.
Data Gaps	Insufficient MEC data are available to characterize and bound this AOC. No data are available for this AOC to support evaluation of potential presence or transport of MC. No visual observations have been made regarding potential erosion features that might indicate potential for transport of MEC from this AOC.

TABLE 4-45
Summary of Previous Investigation Findings for SA93-01

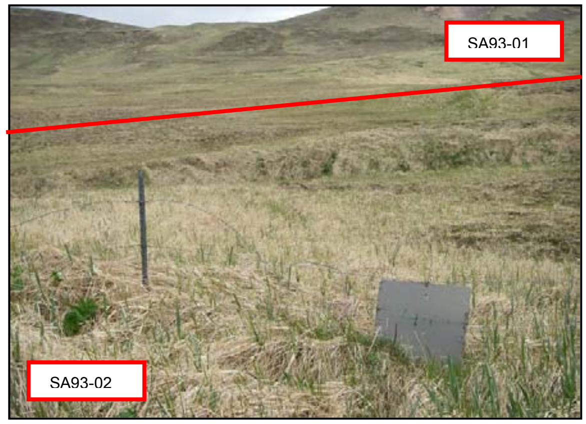
MEC Items Identified	Total Number	Surface	Depth (below ground surface)			
			0 to 0.5 feet	0.5 to 2 feet	2 to 4 feet	> 4 feet
UXO	19	5	7	5	2	0
DMM	2	0	2	0	0	0
MPPEH	11	3	8	0	0	0
MD	89	33	45	11	0	0
Other	58	26	28	4	0	0

Items found:*	
DMM	PD57 fuze (2)
UXO	2.36-inch rocket (armed) 37-mm projectiles, variety of types and conditions (4) 57-mm projectiles, variety of types and conditions (5) 60-mm illumination round (2) 75-mm projectiles, variety of types and conditions (6) 81-mm mortar, possible WP, small pieces of fuze
MPPEH	2.36-inch rocket motor PD 57 fuze remnants (3) 37-mm projectile Fuze – M557 (2) PD 57 fuze remains PD M57 fuze (incomplete) Remains of fuze Tail fuze, 75-mm

*Information in this table is provided to identify the type and depths of ordnance recovered only. It is not intended to be a formal inventory.

4.3.22 SA93-02 Source Area 93 Eastern Impact Area

This AOC is a long, narrow strip (rectangle) running along the eastern edge of SA93-01 (the Source Area 93 Multiple Impact Area). This AOC is bordered by areas lying outside of Parcel 4 to the north, south, and east. SA93-03 (the Source Area 93 Firing Point) and SA93-04 (the Source Area 93 Eastern Disposal Area) are both located wholly within SA93-02. Elevations in this AOC range from about 61 to 91 meters (200 to 300 feet) asl; however, a deep drainage ravine running through the center of this AOC drops to elevation below 12 meters (40 feet) asl. Relevant data and information for this AOC are summarized in Tables 4-46 and 4-47.



SA93-01 and SA93-02

TABLE 4-46
Summary of SA93-02 CSM and Characterization Parameters

Total AOC Area:	**78 acres**	**Accessible AOC Area:**	**55 acres, remainder inaccessible due to steep slopes and ravines**

Access	Direct via gravel road originating from the east side of Andrew Lake near the Recreation Center. The entire historical impact area in which this AOC resides is currently fenced (4-strand barbed wire), with posted signage to deter public access.
Terrain	Generally rolling with the exception of a very steep ravine running through the southern two-thirds of this AOC, from the north-central area to the southwestern corner. This ravine impedes pedestrian ingress from the road on the eastern side.
Vegetation	Generally a mixture of grasses, sedges, mosses, and heaths ranging in height from 12 to 24 inches.
Hydrology Surface Water	Mitchell Creek traverses this AOC in the north-south direction.
Geology/Hydrogeology	Groundwater is anticipated to be deep based on this AOC’s elevation compared with Andrew Lake and Andrew Bay.
Initial AOC Type	Target/Impact Area for mortars based on proximity to SA93-01.
Adjusted AOC Type	Potential Storage Area (or staging site) based on proximity to roadway.
Target Munitions	None known; shotgun casing only found (no ordnance).
Unique Features	Deep ravine through the center of this AOC; standing water observed seasonally.
Potential Transport Mechanisms	Human activities; overland transport by stream in the ravine; transport due to erosion and slumping.
Sensitive Ecological Habitats	Andrew Lake and associated fish-bearing streams.
Approved Level 2 Methodology (2000)	Target/Impact Area approach using transect spacing for 37-mm projectiles (based on the abutting SA93-01 findings).
Previous MEC Investigation	Geophysical survey of approximately 4.1 miles of transect (ribbon walk); intrusive investigation of 72 targets (97% of those identified) to a maximum depth of 4 feet.
Previous MC Investigation	None.
Applicability of Previous Work	Evidence obtained to date does not support the Impact Area AOC type. The Project Team approved evaluation as an area where there is potential for MEC disposal by burial or burning, even though waste found to date is municipal-type waste.
Data Gaps	Insufficient MEC data are available to characterize and bound the AOC, and to confirm the AOC type. No data are available for this AOC to support evaluation of potential presence or transport of MC in the ravine. No visual observations have been made regarding potential erosion features that might indicate potential for transport of MEC from this AOC.

TABLE 4-47
Summary of Previous MEC Investigation Findings for SA93-02

			Depth (below ground surface)			
Items Identified	**Number**	**Surface**	**0 to 1 feet**	**1 to 2 feet**	**2 to 4 feet**	**> 4 feet**
UXO	0	0	0	0	0	0
DMM	0	0	0	0	0	0
MPPEH	0	0	1	0	0	0
MD	1	1	0	0	0	0
Other	103	33	67	2	1	0

4.3.23 SA93-03 Source Area 93 Firing Point

This small, rectangular AOC is located wholly within AOC SA93-02 (the Source Area 93 Eastern Impact Area) near the southern boundary of that AOC. This area was initially believed to be the principal firing point for 2.36-inch rockets (UXO) found within SA93-01 (located across the ravine to the west). On the basis of items found during the 1999 SI, however, this AOC is now thought to be a rocket impact area. Nevertheless, the original name of this AOC has been retained to prevent confusion. The elevation of this AOC is about 29 meters (95 feet) asl, but a deep ravine abuts the site, falling to about 12 meters (40 feet) asl. Relevant data and information for this AOC are summarized in Tables 4-48 and 4-49.

View Looking West/Southwest Across SA93-03. A Concrete Pad, Visible Near the Edge of the Ravine, Potentially May Have Been a Target Stand.

TABLE 4-48
Summary of SA93-03 CSM and Characterization Parameters

Total AOC Area:	**0.6 acre**	**Accessible AOC Area**	**0.4 acre, remainder inaccessible due to steep ravine**
Access	Indirect via walk from gravel road originating from the east side of Andrew Lake near the Recreation Center. The entire historical impact area in which this AOC resides is currently fenced (4-strand barbed wire), with posted signage to deter public access.		
Terrain	Generally flat; a deep ravine abuts the site on the west.		
Vegetation	Low-growing upland tundra species ranging in height from 6 to 12 inches.		
Hydrology/Surface Water	No water features; however, standing water was observed during previous work.		
Geology/Hydrogeology	Groundwater is anticipated to be deep based on this AOC's elevation compared with Andrew Lake and Andrew Bay.		
Initial AOC Type	Firing Point.		
Adjusted AOC Type	Target/Impact Area for rockets.		
Target Munitions	2.36-inch rockets.		
Unique Features	Deep ravine adjacent to this AOC on the west; concrete pad remnants in this AOC.		
Potential Transport Mechanisms	Intrusive human activities.		
Sensitive Ecological Habitats	Andrew Lake and associated fish-bearing streams.		
Approved Level 2 Methodology (2000)	Target/Impact Area approach using transect spacing for 37-mm projectiles (based on the abutting SA93-01 findings).		

TABLE 4-48
Summary of SA93-03 CSM and Characterization Parameters

Previous MEC Investigation	Geophysical survey of approximately 0.1 mile of transect (ribbon walk); intrusive investigation of 9 targets (100% of those identified) to a maximum depth of 4 feet.
Previous MC Investigation	None.
Applicability of Previous Work	Survey does not completely fulfill requirements for survey using 20-m spacing as required for a 37-mm impact area; expansion patterns were not conducted.
Data Gaps	Insufficient MEC data are available to characterize and bound this AOC, and to confirm the AOC type. No data are available for this AOC to support evaluation of potential presence or transport of MC. No visual observations have been made regarding potential erosion features that might indicate potential for transport of MEC from this AOC.

TABLE 4-49
Summary of Previous MEC Investigation Findings for SA93-03

			Depth (below ground surface)			
Items Identified	**Total Number**	**Surface**	**0 to 0.5 feet**	**0.5 to 2 feet**	**2 to 4 feet**	**> 4 feet**
UXO	5	0	2	3	0	0
DMM	0	0	0	0	0	0
MPPEH	1	0	0	1	0	0
MD	1	0	0	1	0	0
Other	3	0	1	2	0	0
Items found:*						
UXO	2.36-inch rocket (5)					
MPPEH	2.36-inch rocket motor					

*Information in this table is provided to identify the type and depths of ordnance recovered only. It is not intended to be a formal inventory.

4.3.24 SA93-04 Source Area 93 Eastern Disposal Area

This AOC consists of a small area located on the eastern border of SA93-02 (the Source Area 93 Eastern Impact Area), abutting the gravel access road serving the former long-range navigation Coast Guard Station to the north. It is bordered by SA93-02 to the north, south, and west, and by an area lying outside of Parcel 4 to the east. The elevation in this small, square AOC is about 76 meters (250 feet) asl. Relevant data and information for this AOC are summarized in Tables 4-50 and 4-51.

TABLE 4-50
Summary of SA93-04 CSM and Characterization Parameters

Total AOC Area:	**0.25 acre** **Accessible AOC Area: 0.25 acre**
Access	Direct via gravel road originating from the east side of Andrew Lake near the Recreation Center. The entire historical impact area in which this AOC resides is currently fenced (4-strand barbed wire), with posted signage to deter public access.
Terrain	Relatively flat.
Vegetation	Generally a mixture of grasses, sedges, mosses, and heaths ranging in height from 12 to 24 inches.
Hydrology/Surface Water	No standing water features expected; however, standing water was observed during the previous investigations.
Geology/Hydrogeology	Groundwater is anticipated to be deep based on this AOC's elevation compared with Andrew Lake and Andrew Bay, although standing water and marshy areas have been observed.

TABLE 4-50
Summary of SA93-04 CSM and Characterization Parameters

Initial AOC Type	Target/Impact Area.
Adjusted AOC Type	Potential Storage Area.
Target Munitions	None known; only shipping crate lid for 155-mm projectiles found (no ordnance found).
Unique Features	Adjacent to roadway on the east; very small AOC.
Potential Transport Mechanisms	Human activities.
Sensitive Ecological Habitats	Andrew Lake and associated fish-bearing streams.
Approved Level 2 Methodology (2000)	Target/Impact Area approach using transect spacing for 37-mm projectiles.
Previous MEC Investigation	Geophysical survey of approximately 33 meters (100 feet) of transect (ribbon walk); intrusive investigation of one target (100% of those identified) to a maximum depth of 4 feet.
Previous MC Investigation	None.
Applicability of Previous Work	Survey does not completely fulfill requirements for survey using 20-m spacing as required for a potential 37-mm impact area; expansion patterns were not conducted; 30-m grids were not placed in areas indicated to have different ordnance-related item densities. However, it should be noted that evidence obtained to date does not support the Impact Area model. The Project Team approved evaluation as a possible storage area.
Data Gaps	Insufficient MEC data are available to characterize and bound the AOC, and to confirm the AOC type.

TABLE 4-51
Summary of Previous MEC Investigation Findings for SA93-04

Items Identified	Total Number	Surface	Depth (below ground surface)			
			0 to 1 feet	1 to 2 feet	2 to 4 feet	> 4 feet
UXO	0	0	0	0	0	0
DMM	0	0	0	0	0	0
MPPEH	0	0	0	0	0	0
MD	0	0	0	0	0	0
Other	1	1	0	0	0	0

SECTION 5

2008 Investigation

This section describes how the 2008 OU B-2 remedial investigation was conducted and presents the results of the 2008 investigation for the definable features of work (DFWs) for the 2008 RI as identified in the MEC and MC quality assurance project plans (QAPPs) (Tetra Tech, 2008), and for each OU B-2 AOC where data were collected in 2008.

Section 5.1 provides a review of the MEC and MC data gaps identified for each AOC. Section 5.2 describes the DFWs for the MEC portion of the RI, and Section 5.3 provides the DFW results and conclusions. Section 5.4 describes the DFWs for the MC portion of the RI, and Section 5.5 provides the DFW results and conclusions. Section 5.6 presents the MEC and MC investigation results for the OU B-2 AOCs included in the RI. Although technically not part of the RI for OU B-2, the sampling program at RG-01 is described in Section 5.7 because data for these samples were incorporated into the overall risk screening evaluation for OU B-2.

5.1 Summary of Data Gaps

The existing data for each AOC were reviewed in the context of the Level 2 assessment methodology presented in Section 4.2 and RI/FS requirements in order to identify data gaps and establish data quality objectives (DQOs) for the 2008 RI. DQOs were established for MEC data needs and for MC data needs, and they were detailed in the MEC and MEC QAPPs attached to the 2008 RI Work Plan (Tetra Tech, 2008). Table 5-1 provides a summary of the data gaps that were identified in the work plan for each AOC and summarized in Section 4.

TABLE 5-1
Summary of 2008 RI Data Gaps

AOC	AOC Type	2008 RI Gaps[a]
ALDA-01	Large-Scale Burial/Disposal Area	Instrument-aided evaluation of the craters and intrusive investigation of up to 10 subsurface anomalies in each crater (if conditions permit). Sampling surficial soil from the bottom of one crater (3-point composite) and analysis of the sample for MC.
ALDA-02	Aerial Bombing Range	None—AOC was classified as NOFA for MEC because bedrock is shallow, which would promote high order detonation of any bombs dropped. One MC sediment sample obtained from the bed of the stream originating in C1-01, which flows to the north through ALDA-02 into Andrew Bay.
ALSW-01	Disposal Area Wash-Up Area for Offshore MEC	Geophysical survey and intrusive investigation along transects spaced at 10 to 15 m in accessible locations along the top and sides of the seawall and in beach locations where possible. 100% geophysical survey and intrusive investigation of a 30-m x 30-m grid centered on the newly discovered potential upland small arms burial site. Execution of expansion grids as needed per the Level 2 disposal area approach. One MC soil sample collected if a breached item or cluster of items exhibiting evidence of potential MC contamination discovered during the intrusive investigation (not related to items washed ashore on beach).
BC-03	Firing Point	None—AOC was classified as NOFA because 100% survey was conducted, all contacts were intrusively investigated, and no MEC items were found.
C1-01	Target/Impact Area	One MIS soil sample location along the eastern edge of the AOC where an anomaly was found that could have been a breached item. The sample will be analyzed for MC. Visual inspection for site features indicative of erosion and site instability that could be a factor in potential MEC migration. DGM accessibility (slope) evaluation along eastern boundary of AOC. One MIS soil sample will be collected if conditions found during the observation of erosion features indicate that this is warranted.

TABLE 5-1
Summary of 2008 RI Data Gaps

AOC	AOC Type	2008 RI Gaps[a]
HG-01	Target/Impact Area	Site reconnaissance consisting of intrusive investigation of 25 target anomalies identified during previous investigations. Geophysical and intrusive investigation of two 30-m x 30-m grids centered on the two MEC finds from prior investigations. One MIS soil sample collected if a breached item or cluster of items exhibiting evidence of potential MC contamination is discovered during the investigation of the grids or during site reconnaissance.
JM-01	Disposal Area	None—AOC classified as NOFA because disposal area was not located.
LJ-02A	Disposal Area	None—AOC classified as NOFA because 100% survey was conducted, all contacts were intrusively investigated, and no MEC items were found.
MAG-01	Storage Magazine	Site reconnaissance (instrument-aided visual inspection) of the accessible portions of the site. Need for potential follow-on work will be discussed after the results of the reconnaissance are reviewed.
MI-01	Target/Impact Area	100% geophysical survey and intrusive investigation of two 30-m x 30-m grids centered on the locations where rockets were found in 1999. Execution of expansion grids (if warranted) per the Level 2 disposal area approach. One MIS soil sample collected at the location of rockets found in 1999. The sample will be analyzed for MC and perchlorate. Additional MIS soil sample collected if a breached item or cluster of items exhibiting evidence of potential MC contamination discovered during the investigation of the grids.
MI-02	Target/Impact Area	Geophysical survey and intrusive investigation of a series of transects spaced at 25 m in the western portion of the AOC and two transects in the southern and northern portions of the AOC where no characterization has been done to complete the Level 2 approach for a 40 mm projectile impact area. Geophysical and intrusive investigation of two 30-m x 30-m grid centered on prior MEC finds and two additional 30-m x 30-m grids located near the AOC boundaries[b] to obtain additional information for FS analysis and for estimating purposes. One MIS soil sample collected in the location of a former anomaly find that may have been a breached item. The sample will be analyzed for MC and perchlorate. If seeps are present and accessible, up to two groundwater seep samples will be collected in this AOC and will be used to assess potential exposure and the potential for MC transport or migration from impact on upper slopes or from further up on Mt. Moffett. The seep samples (if obtained) will be analyzed for MC and perchlorate. One MIS soil sample will also be collected if a breached item or cluster of items exhibiting evidence of potential MC contamination is discovered during the investigation of the grids. Visual inspection for observation of site features indicative of erosion and site instability that could be a factor for potential MEC migration.

TABLE 5-1
Summary of 2008 RI Data Gaps

AOC	AOC Type	2008 RI Gaps[a]
MI-03	Target/Impact Area	Geophysical survey and intrusive investigation of a series of transects spaced at 25 m in the eastern portion of the AOC where no characterization has been done to complete the Level 2 approach for a 40 mm projectile impact area. Geophysical survey and intrusive investigation of a series of supplemental transects designed to fill in the original mapping to form a transect pattern with a spacing of approximately 50 m in the western and central portion of the site to fill the gaps in the Level 2 sampling pattern for a mortar impact area. 100% geophysical survey and intrusive investigation (site reconnaissance) of one 30-m x 30-m grid in the southeastern end of the northern valley, and one 30-m x 30-m grid just to the west of the OB/OD to obtain additional information for the FS and for estimating purposes.[c] Execution of expansion grids will be done (if warranted) per the Level 2 impact area approach. Two MIS soil samples collected in this AOC in locations where anomalies and clusters of anomalies that may have been breached were found during prior investigations. The samples will be analyzed for MC and perchlorate. One MIS soil sample will also be collected if a breached item or cluster of items exhibiting evidence of potential MC contamination is discovered during the investigation of the grids, site reconnaissance, or transects. Visual inspection for observation of site features indicative of erosion and site instability that could be a factor for potential MEC migration.
MM-10D	Target/Impact Area	None—AOC classified as NOFA because agreed-to survey (XT pattern and 5-m spaced transects) was conducted, all contacts were intrusively investigated, and no MEC items were found
OB/OD-01	OB/OD Area	Three MIS soil samples were collected in the centerline of the area near locations of specific anomalies found during prior investigations that may have been breached items. The samples will be analyzed for MC and perchlorate. One MIS soil sample will also be collected from this area to be evaluated for geotechnical parameters using ASTM D-422. These parameters may be needed for evaluation of remedial alternatives in the FS (i.e., to evaluate potential mechanical screening to remove MEC, which may be an option considered in the FS).
RG-01	Target/Impact Area	None—completion of NTCRA in 2008.
RR-01	Target/Impact Area	Geophysical survey and intrusive investigation of a series of transects spaced at 20 m in the uncharacterized accessible areas in the northern portion of the AOC starting along the northern base of the steep slope (excluding the former known distance rifle range area). Execution of expansion grids as needed per the Level 2 impact area approach. Site reconnaissance (instrument-aided visual inspection) in the accessible areas of the southern portion of the AOC. One sediment sample collected within Moffett Creek just upstream from the former rifle range area. The sample will be analyzed for MC and perchlorate. One MIS soil sample will be collected if a breached item or cluster of items exhibiting evidence of potential MC contamination is discovered during the investigation of the grids, site reconnaissance area, or transects. Visual inspection for observation of site features indicative of erosion and site instability that could be a factor for potential MEC migration.

TABLE 5-1
Summary of 2008 RI Data Gaps

AOC	AOC Type	2008 RI Gaps[a]
RR-02	Target/Impact Area	Geophysical survey and intrusive investigation of a series of transects spaced at 25 m in the uncharacterized accessible areas in the north central portions of the AOC. Execution of expansion grids (if warranted) per the Level 2 impact area approach. Site reconnaissance (instrument-aided visual inspection) in the northeastern, southwestern, and western portions of the AOC where access is limited. One MIS soil sample collected near the northern tip of RG-01 in the location of a cluster of items found during prior investigations where items may have been breached. The sample will be analyzed for MC and perchlorate. One MIS soil sample will also be collected if a breached item or cluster of items exhibiting evidence of potential MC contamination is discovered during the investigation of the grids, site reconnaissance area, or transects. Visual inspection for observation of site features indicative of erosion and site instability that could be a factor for potential MEC migration.
RR-03	Range Buffer Zone	None[d]—Geophysical survey conducted, all contacts intrusively investigated, all MEC items cleared.
RR-04	Range Buffer Zone	Geophysical and intrusive investigation of two transects situated in areas where previous data do meet the Level 2 spacing required for a combat range (which is the model adopted for this AOC since none exists for a buffer area). Site reconnaissance (instrument-aided visual inspection) in the accessible areas of the southwest corner of the AOC. One MIS soil sample will also be collected if a breached item or cluster of items exhibiting evidence of potential MC contamination is discovered during the investigation site reconnaissance areas or transects. Two sediment samples collected from two locations in Moffett Creek, one about midway through the AOC and the other near the mouth of Moffett Creek (west of the road paralleling Andrew Lake). The sediment sample near the lake will be co-located with the surface water sample noted below. These samples will be analyzed for MC and perchlorate. One surface water sample co-located with the sediment sample nearest Andrew Lake. The sample will be analyzed for MC and perchlorate. Six shallow groundwater samples collected (three on either side of Moffett Creek) near the Andrew Lake shoreline. These samples will be analyzed for MC and perchlorate.
SA-01	Small Arms Range	100% geophysical survey and intrusive investigation of one 30-m x 30-m grid centered on the area where the buried small arms munitions were found. Execution of expansion grids as needed per the Level 2 impact area approach. Site reconnaissance (instrument-aided visual inspection) in the remainder of the accessible areas of the AOC. One MIS soil sample will be collected if a breached item or cluster of items exhibiting evidence of potential MC contamination is discovered during the investigation of the grids or site reconnaissance.

TABLE 5-1
Summary of 2008 RI Data Gaps

AOC	AOC Type	2008 RI Gaps[a]
SA93-01	Target/Impact Area	Geophysical survey and intrusive investigation of a series of transects spaced at 20 m (37 mm projectiles) in the uncharacterized accessible areas in the central portion of the AOC. Geophysical survey and intrusive investigation of a series of transects spaced at 20 m in the northeast corner of the AOC where OE scrap was previously found. Geophysical survey and intrusive investigation of a transect along the base of the hill at the western side of the AOC at the line where wasting and falling material from the hillside collects. 100% geophysical survey and intrusive investigation of one 30-m x 30-m grid near the southeastern corner of the AOC, centered on the location of a 2.36-inch rocket found during 1999. Execution of expansion grids as needed per the Level 2 impact area approach. DGM accessibility (slope) evaluation along eastern and western margins of AOC. Two MIS soil samples collected in locations of two anomalies found during prior investigations that were noted as being breached items. The samples will be analyzed for MC and perchlorate. One co-located sediment and surface water sample collected at the junction of the two drainage channels that converge just south of the AOC boundary. Both the sediment and surface water sample will be analyzed for MC and perchlorate. One MIS soil sample will also be collected if a breached item or cluster of items exhibiting evidence of potential MC contamination is discovered during the investigation of the grid or transects. Visual inspection for observation of site features indicative of erosion and site instability that could be a factor for potential MEC migration.
SA93-02	Disposal Area	Site reconnaissance (instrument-aided visual inspection) of the accessible portions of the site. One co-located sediment and surface water sample collected within the Mitchell Creek drainage channel at the southern end of the AOC. Both the sediment and surface water sample will be analyzed for MC and perchlorate. One MIS soil sample will be collected if a breached item or cluster of items exhibiting evidence of potential MC contamination is discovered during the investigation of the grid or transects. Visual inspection for observation of site features indicative of erosion and site instability that could be a factor for potential MEC migration.
SA93-03	Target/Impact Area	100% geophysical survey and intrusive investigation of the accessible portions of the AOC (no approved transect spacing for rockets). Accessibility in this location (western and northwestern portion of the AOC) will be determined in the field based on terrain. Execution of expansion grids as needed per the Level 2 impact area approach. One MIS soil sample collected at the location where a cluster of expended rockets was found during prior investigations. The sample will be analyzed for MC and perchlorate. One MIS soil sample will be collected if a breached item or cluster of items exhibiting evidence of potential MC contamination is discovered during the grid investigation. Note: Due to the small AOC size, this sample may not be taken should it significantly (over 50%) overlap the soil sample location noted above.
SA93-04	Storage Area	Instrument-aided reconnaissance of the AOC to identify potential evidence of burial or disposal. One MIS soil sample will be collected if a breached item or cluster of items exhibiting evidence of potential MC contamination is discovered during the reconnaissance.

[a]Requirements as listed in Table 5-2 and shown on Figures A through Z in the RI Work Plan (Tetra Tech, 2008), unless otherwise indicated.

[b]One grid was listed in Table 5-2 and shown on Figure M. Three grids were added prior to onset of field work to obtain additional information for the FS and for estimating purposes.

[c]While Table 5-2 lists two grids at MI-03, Figure N only shows one of the grids. This error was rectified prior to the onset of field work.

5.2 2008 MEC Investigation Field Activities

This section describes the investigation methods and summarizes the results for the MEC portion of the 2008 RI field work. All field procedures and documentation were accomplished in accordance with the approved 2008 RI Work Plan (Tetra Tech, 2008), standard operating procedures (SOPs), the MEC QAPP, and field change requests (FCRs). The 2008 RI field work was conducted by USA Environmental (USAE), with subcontracted support from NAEVA Geophysics and CH2M HILL. Battelle served as the Government QA contractor.

The DFWs and subtasks associated with the 2008 MEC investigation were detailed in Worksheet (WS) #14 of the MEC QAPP, and the specific quality control inspection points and criteria for each were outlined in WS #34 and #35 of the MEC QAPP. The DFWs and subtasks for the 2008 MEC investigation, included:

- Certification and Training:
  - GPO Certification/3 Phase Inspections
- Site Preparation:
  - Grid/Transect Construction
  - Vegetation Removal/Debris Removal
  - Geodetic Survey
- Data Acquisition:
  - Site Reconnaissance
  - Observation of Physical Features Indicative of Erosion or Instability
  - Geophysical Data Collection
- Geophysical Anomaly Identification:
  - Data Processing
  - Data Analysis
  - Data Management
- Anomaly Resolution:
  - Anomaly Reacquisition
  - Anomaly Excavation
  - Target Validation Check
  - Analog (Mag and Dig) Operations
  - MEC Disposal
  - Munitions Debris Management
- Product QC:
  - Tier 3 QC Process Using MISTAD 1916 Acceptance Sampling Protocol
- Site Restoration:
  - Backfill
  - Police Area
  - Scrap Management
- Reporting Results:
  - Presentation of Results

The procedures and requirements for each of the DFW subtasks, including QC processes, are described in the following subsections. The QC requirements for each DFW are listed in Table 5-2. Additional details and documentation for the 2008 MEC investigation activities are provided in the following appendixes:

- Appendix A – Reconnaissance Reports
- Appendix B – Intrusive Summary
- Appendix C – MEC Field Documentation (electronic only)

TABLE 5-2
QC Requirements for MEC Investigation DFWs

DFW	Project Quality Processes	Frequency of Oversight Activity	Reference/ SOP	Forms	Quality Control Procedure	Corrective Action Criteria
Certification and Training	Training	Initially and as personnel are added	RI Work Plan Section 11; MEC QAPP WS #34	Personnel Qualification Form	Verify that all personnel possess the requisite training and experience for the position assigned.	Personnel deemed to be unqualified will be replaced or provided training prior to conducting tasks for which training is required.
	Document Review	Initially and as documents are changed	MEC QAPP WS #35	QC Daily QC Surveillance Document Review Form	Verify a document review has been conducted on all project documents. Verify the document review is documented on the document review form.	Document review not conducted or documented. Where appropriate, a Nonconformance Report will be issued and a causal analysis/corrective action will be developed.
GPO Certification		Prior to beginning field work or when an uncertified person is assigned to geophysical or reacquire teams	GPO Certification Plan; MEC QAPP WS #34	GPO DGM Certification Form	Validate ability of system, personnel, and procedures to attain contract required score of 0.85 probability of detection at a 90% confidence level.	
Preparatory Phase Inspection		Prior to beginning each DFW	MEC QAPP WS #34	QC Preparatory Phase Inspection Form	Inspection reviews applicable specifications for DFW and verifies that the necessary resources, conditions, and controls are in place and compliant before the start of work activities.	

TABLE 5-2
QC Requirements for MEC Investigation DFWs

DFW	Project Quality Processes	Frequency of Oversight Activity	Reference/ SOP	Forms	Quality Control Procedure	Corrective Action Criteria
Initial Phase Inspection		First time a parcel of work is performed on every DFW	MEC QAPP WS #34	QC Initial Inspection	Check the preliminary work for compliance with procedures and contract specifications, and to establish the acceptable level of workmanship, check safety compliance, review the preparatory phase inspection, check for omissions, and resolve differences of interpretation. Verification that deficiencies identified during the preparatory phase has been corrected. Verification that requirements of quality of workmanship have been established. Review of work plan and applicable documents to ensure that the requirements are being met. Observation of work to verify the adequacy of the work.	Discrepancy between site work and approved plans/procedures Where appropriate, a Nonconformance Report will be issued and a causal analysis/corrective action will be developed.
Follow-up Phase Inspection		Weekly on every DFW	MEC QAPP WS #34	QC Follow-up Surveillance	Verification of continued compliance with the specifications and requirements of the statement of work and approved SOPs. Ensure that the work is in compliance with the work plans. Ensure that the required level of workmanship is maintained. Ensure that the project logbook is properly filled out and maintained.	Any element not conforming to the specifications. Where appropriate, a Nonconformance Report will be issued and a causal analysis/corrective action will be developed.

TABLE 5-2
QC Requirements for MEC Investigation DFWs

DFW	Project Quality Processes	Frequency of Oversight Activity	Reference/ SOP	Forms	Quality Control Procedure	Corrective Action Criteria
Site Preparation	Debris Removal	Upon task completion for each area	MEC QAPP WS #34; SOP 1	QC Daily QC Preparatory Inspection QC Initial Inspection QC Follow-up Surveillance	Verify all metallic debris that may interfere with geophysical mapping or endanger the field personnel is removed from the walking surface prior to the geophysical survey. Verify all munitions hazards have been removed from the area selected to be cleared. Verify field notes and logbooks are accurate, complete, and consistent.	Any element not conforming to the specifications. Where appropriate, a Nonconformance Report will be issued and a causal analysis/corrective action will be developed.
	Vegetation Removal	Upon task completion for each area	MEC QAPP WS #34; SOP 11	QC Daily QC Preparatory Inspection QC Initial Inspection QC Follow-up Surveillance	Ensure and verify that the ground surface of the grid has been cleared of all vegetation as much as possible based on obstacles and terrain. Verify field notes and logbooks are accurate, complete, and consistent.	Any element not conforming to the specifications. Where appropriate, a Nonconformance Report will be issued and a causal analysis/corrective action will be developed.

TABLE 5-2
QC Requirements for MEC Investigation DFWs

DFW	Project Quality Processes	Frequency of Oversight Activity	Reference/ SOP	Forms	Quality Control Procedure	Corrective Action Criteria
	Grid or Transect Construction	Per occurrence	MEC QAPP WS #34; SOP 2	QC Daily QC Preparatory Inspection QC Initial Inspection QC Follow-up Surveillance	Verify coordinate system and units as required from statement of work SOW. Relative coordinate systems (if utilized) require field sketch map with north arrow provided. Verify metal nails are in place at grid corner locations or as required along transects. Verify corner points or transect markers are clearly marked and legible. Verify field notes and logbooks are accurate, complete, and consistent. Verify field acquisition setup (GPS or relative coordinates) by occupying a grid corner or known control monument. Each positioning system (GPS or relative coordinates) requires special setup parameters depending upon the project objectives that shall be explained to and implemented by the survey field crews (e.g., field guidelines or field requirements).	Any element not conforming to the specifications. Where appropriate, a Nonconformance Report will be issued and a causal analysis/corrective action will be developed.

TABLE 5-2
QC Requirements for MEC Investigation DFWs

DFW	Project Quality Processes	Frequency of Oversight Activity	Reference/ SOP	Forms	Quality Control Procedure	Corrective Action Criteria
	Geodetic Survey	Per occurrence	MEC QAPP WS #34; SOP 3	QC Daily QC Preparatory Inspection QC Initial Inspection QC Follow-up Surveillance	Verify location consistency between all primary control points and monuments (office and field checks). Verify coordinate system and units as required from SOW. Verify field crew knowledge of “relative” coordinate systems if used (North and East+, West and South -). Reacquire grid corner points from survey subcontractor in the appropriate coordinate system if necessary. ☐Reacquire“true” horizontal and slope distance measurements for control points from survey subcontractor depending upon positioning system used. Visually inspect field work (slope distance between corner stakes). Verify existence of corner stakes by the emplacement of metal rebar or nails.	Any element not conforming to the specifications. Where appropriate, a Nonconformance Report will be issued and a causal analysis/corrective action will be developed.

TABLE 5-2
QC Requirements for MEC Investigation DFWs

DFW	Project Quality Processes	Frequency of Oversight Activity	Reference/ SOP	Forms	Quality Control Procedure	Corrective Action Criteria
Data Acquisition	Site Reconnaissance and Instrument-aided Visual Inspections	Daily	MEC QAPP WS #34; SOP 1, SOP 9	QC Daily QC Preparatory Inspection QC Initial Inspection QC Follow-up Surveillance	Review maps of all areas of concern to ensure completeness. Verify that the areas of concern maps include legend, scale, north arrow, figure number, revision date, page number, grid corner stakes, and perimeter or waypoint stakes. Verify that grid corner stakes, perimeter stakes, and/or waypoint stakes are correctly marked on maps and in the field. Verify geo maps are in color and have state plane coordinates, north arrow, and distance scale. Verify correct lane spacing is implemented and maintained. Verify daily instrument checks are conducted (as appropriate).	Any element not conforming to the specifications. Where appropriate, a Nonconformance Report will be issued and a causal analysis/corrective action will be developed.
	Observation of Physical Features Indicative of Erosion or Instability	Daily	MEC QAPP WS #34; SOP 1, SOP 9	QC Daily QC Preparatory Inspection QC Initial Inspection QC Follow-up Surveillance	Review maps of all areas of concern to ensure completeness. Verify that the areas of concern maps include: legend, scale, north arrow, figure #, revision date, page number, grid corner stakes and perimeter or waypoint stakes. Verify that grid corner stakes, perimeter stakes, and/or waypoint stakes are correctly marked on maps and in the field. Verify geo maps are in color and have state plane coordinates, north arrow, and distance scale. Verify that areas are being observed, appropriate information is recorded, and photographs are being taken as required.	Any element not conforming to the specifications. Where appropriate, a Nonconformance Report will be issued and a causal analysis/corrective action will be developed.

TABLE 5-2
QC Requirements for MEC Investigation DFWs

DFW	Project Quality Processes	Frequency of Oversight Activity	Reference/ SOP	Forms	Quality Control Procedure	Corrective Action Criteria
	Geophysical Data Collection	Weekly	MEC QAPP WS #34; SOP 2	QC Daily QC Preparatory Inspection QC Initial Inspection QC Follow-up Surveillance	Verify communication between the team leaders, processing and interpretation geophysicist(s) and site geophysicist (or manager) is established and maintained. Verify the required daily and weekly equipment checks are performed. Verify any pre-project tests are performed and digitally documented. These tests are defined in the GPO Certification Plan. Verify equipment is secure in the vehicle and in storage onsite. Verify a safe and effective power charging station is setup and maintained by a designated data collector. Document equipment that is damaged or deemed “not working” by serial number. Verify ability to properly setup the equipment. Verify ability to perform required standard QC field tests as specified in the SOP for geophysical data acquisition. Verify ability to monitor data prior to and during acquisition to ensure the data are of sufficient quality and quantity to meet the project objectives. Verify consistency in navigation (line spacing, data coverage around obstacles). Verify instrument height above ground surface as determined during GPO. Verify ability to correctly name acquisition files, download, and transfer data. Verify quality and clarity of field notes. Verify that data transfer protocols are being followed. Verify field notes and logbooks are accurate, complete, and consistent.	Any element not conforming to the specifications. Where appropriate, a Nonconformance Report will be issued and a causal analysis/corrective action will be developed.

TABLE 5-2
QC Requirements for MEC Investigation DFWs

DFW	Project Quality Processes	Frequency of Oversight Activity	Reference/ SOP	Forms	Quality Control Procedure	Corrective Action Criteria
Geophysical Anomaly Identification	Geophysical Data Processing	Per data set	MEC QAPP WS #34; SOP 3	QC Daily QC Preparatory Inspection QC Initial Inspection QC Follow-up Surveillance	Verify a data acquisition log is maintained (preferably digital). Verify a processing/interpretation log is maintained (preferably digital). Verify file management system includes team ID, date, survey area, and file designator so that there are no duplicate file names. Verify data are stored by date, and that the original raw data are NEVER compromised; copy raw data to “process folder” prior to processing. Verify that files stored by date are “merged” as necessary into grids or transects that are more readily useable by other project personnel (PM, client, etc.). Verify processing and analysis efforts are documented in the appropriate digital files. Verify geophysical data are in the coordinate system(s) required by the client. Verify instrument bias is removed, signal drift is corrected (leveled), and minor instrument positioning (lag and/or latency) corrections applied. Verify known control points (e.g., grid corners or transect waypoints) show up in the data at the correct coordinate location +- the agreed upon error in the work plan.	Any element not conforming to the specifications. Where appropriate, a Nonconformance Report will be issued and a causal analysis/corrective action will be developed.

TABLE 5-2
QC Requirements for MEC Investigation DFWs

DFW	Project Quality Processes	Frequency of Oversight Activity	Reference/ SOP	Forms	Quality Control Procedure	Corrective Action Criteria
					If data are sent to the centralized processing/ interpretation center, a "chain of custody" method should be employed (i.e., e-mail). Geophysical QC personnel should check that the processing and interpretation scheme is consistent with meeting the objectives as stated in the WP. Geophysical QC personnel should also track the version of the processing software being used and if software modifications occur during project execution. Any large-scale changes to the processing strategy should be documented as effective by performance on and comparison to the GPO.	
	Geophysical Data Analysis	Daily	MEC QAPP WS #34; SOP 3	QC Daily QC Preparatory Inspection QC Initial Inspection QC Follow-up Surveillance	Verify data interpretation parameters are defined in the WP or the field guidelines for that task PRIOR to data acquisition. Verify that the specific interpretation criteria (contours, color scheme, plotting of track path, etc.) and classification scheme are documented and followed by the interpreters, especially when there are multiple interpreters. Verify a dig sheet is generated including a target information table and graphical representations of the test grid geophysical data.	Any element not conforming to the specifications. Where appropriate, a Nonconformance Report will be issued and a causal analysis/corrective action will be developed.

TABLE 5-2
QC Requirements for MEC Investigation DFWs

DFW	Project Quality Processes	Frequency of Oversight Activity	Reference/ SOP	Forms	Quality Control Procedure	Corrective Action Criteria
	Geophysical Data Management	Per data set	MEC QAPP WS #34; SOP 3	QC Daily QC Preparatory Inspection QC Initial Inspection QC Follow-up Surveillance	Verify project data are managed in an MS Access database (or equivalent). Verify transfers of data to site geophysicist for processing are conducted daily. Verify consistency/discrepancies between interpreted and excavated anomaly's results. Verify all data are backed up on a daily basis. Compare dig results with geo target anomaly dig sheets and maps to ensure dig results are representative of geophysical anomaly characteristics (Data Verification Check). Verify interpreted anomalies have been intrusively investigated (as required) and documented (Data Verification Check).	Any element not conforming to the specifications. Where appropriate, a Nonconformance Report will be issued and a causal analysis/corrective action will be developed.

TABLE 5-2
QC Requirements for MEC Investigation DFWs

DFW	Project Quality Processes	Frequency of Oversight Activity	Reference/ SOP	Forms	Quality Control Procedure	Corrective Action Criteria
Anomaly Resolution	Anomaly Reacquisition	Weekly	MEC QAPP WS #34; SOP 4	QC Daily QC Preparatory Inspection QC Initial Inspection QC Follow-up Surveillance	Verify data are loaded onto the positioning system in the correct format and the filename is consistent with the dig sheet nomenclature. Reacquire at least one known control point prior to reacquiring any anomalies (grid corner, transect waypoint, geodetic control point, etc.) and check if the offset from the known point is within tolerance specified in SOP 3 and WS #12. Verify targets are relocated and flagged in the field with the correct ID from the dig sheet. Verify the reacquired location is digitally recorded by the positioning system with the same target ID that is present on the dig sheet. ☐Check 10% of the reacquired versus interpreted coordinates to ensure within tolerance specified in WP. Verify Reacquire team is marking the flags and placing them in the ground far enough to prevent them from coming out. Verify there is effective communication between the Reacquire team and the site geophysicist or data processing center.	Any element not conforming to the specifications. Where appropriate, a Nonconformance Report will be issued and a causal analysis/corrective action will be developed.

TABLE 5-2
QC Requirements for MEC Investigation DFWs

DFW	Project Quality Processes	Frequency of Oversight Activity	Reference/ SOP	Forms	Quality Control Procedure	Corrective Action Criteria
	Anomaly Excavation	Weekly	MEC QAPP WS #34; SOP 4	QC Daily QC Preparatory Inspection QC Initial Inspection QC Follow-up Surveillance	Check 10% of holes to ensure holes are clear of MEC/MPPEH. If hole is annotated as "left in place," verify description is correct. Check for acceptable backfill of holes. Verify feedback protocols are implemented (Intrusive team leaders communicate with the project geophysicist regarding the intrusive results). Verify dig results are being validated (ensures all anomalies are excavated and validated based on the size of the item recovered compared to the geophysical signature). If an area of interest is identified for mag and dig, verify that all targets within the area have been flagged and investigated.	Any element not conforming to the specifications. A grid will require causal analysis/corrective action if a MEC item or MEC look-alike is located above the detectable depth Failed grids will be returned to the intrusive team for cure. Where appropriate, a Nonconformance Report will be issued and a causal analysis/ corrective action will be developed. The Senior UXO Supervisor will be notified if holes are not being backfilled entirely.
	Target Validation Check	Every other day	MEC QAPP WS #34; SOP 4	QC Daily QC Surveillance Inspection	Work with the Site Geophysicist to verify that the excavation results validate the data interpretation and resulting dig lists turned in by the excavation teams. Verify the selections are reacquired and investigated. QC must review the results from this activity.	Any element not conforming to the specifications. A grid will require causal analysis/corrective action if a MEC item or MEC look-alike is located in the grid during QC activities Failed grids will be returned to the geo for reevaluation and where appropriate, a Nonconformance Report will be issued and a causal analysis/corrective action will be developed.

TABLE 5-2
QC Requirements for MEC Investigation DFWs

DFW	Project Quality Processes	Frequency of Oversight Activity	Reference/ SOP	Forms	Quality Control Procedure	Corrective Action Criteria
	MEC Disposal	Per disposal event	MEC QAPP WS #34; SOP 7	QC Daily QC Preparatory Inspection QC Initial Inspection QC Follow-up Surveillance	Verify receipt and turn in of class V explosives conducted in accordance with procedures. Required notifications are made prior to disposal operations are made. Verify all personnel are accounted for. Verify disposal shots are set up safely and in accordance with procedures. Verify miss-fire procedures are utilized if necessary with proper wait-times observed. Verify proper reentry control is utilized when checking/verifying shot holes after detonation. (2 man rule, 1 utilized as safety observer.)	Any element not conforming to the specifications. Where appropriate, a Nonconformance Report will be issued and a causal analysis/corrective action will be developed.
	Munitions Debris (Scrap Management)	Twice weekly	MEC QAPP WS #34	QC Daily QC Preparatory Inspection QC Initial Inspection QC Follow-up Surveillance	Observe the Debris Processing procedure. Inspect 10% of the debris.	Any MEC found in Scrap Processing Area. Any element not conforming to the specifications. Where appropriate, a Nonconformance Report will be issued and a causal analysis/corrective action will be developed.
Site Restoration	Backfill (as necessary)	As needed	MEC QAPP WS #34; SOP 10	QC Daily QC Surveillance Inspection	Verify that backfill procedures are completed in areas that have passed QC final acceptance.	The Senior UXO Supervisor will be notified if holes are not being backfilled entirely.
	Police Area (debris removal)	As needed	BMP	QC Daily QC Surveillance Inspection	Verify field teams have properly policed work areas prior to moving into other areas to work and prior to handing area into final acceptance sampling.	The Senior UXO Supervisor will be notified if debris is still present when area is inspected.
Product QC	See Table 5-3					

TABLE 5-2
QC Requirements for MEC Investigation DFWs

DFW	Project Quality Processes	Frequency of Oversight Activity	Reference/ SOP	Forms	Quality Control Procedure	Corrective Action Criteria
Reporting Results		As needed	RI Work Plan	QC Daily QC Surveillance Inspection	Verify that the data entry is complete, accurate, and consistent and meets Data Quality Objectives. Verify data are being recorded in real time, not after the fact. Verify that documents and records submitted to Project Files are legible and complete. Verify a document review has been conducted on all project documents.	Any element not conforming to the specifications. Where appropriate, a Nonconformance Report will be issued and a causal analysis/corrective action will be developed.

5.2.1 Certification and Training

This section describes the certification and training procedures for the MEC investigation, including personnel training requirements, the testing of geophysical equipment at the geophysical prove-out (GPO) and instrument test strip (ITS), and the 3-phase QC inspection process, in accordance with the 2008 RI Work Plan, the MEC QAPP DFWs, and the Environmental Protection Plan/Waste Management Plan (EPP/WMP) included in the 2008 RI Work Plan.

5.2.1.1 Training Requirements

USAE personnel mobilized to Adak in June 2008; upon arrival they inventoried and inspected equipment from the barge shipment and established an administrative area in a leased set of quarters on Adak. USAE performed site-specific training, coordinated communications and other support, confirmed that all personnel had the proper qualifications and training records, coordinated medical evacuation (MedEvac) flights and medical support on Adak, installed the Type II Explosive Magazine (for MPPEH storage) near OB/OD-01, and coordinated project details with City of Adak personnel, specifically with the city manager.

Training was conducted by the Senior UXO Supervisor (SUXOS), the UXO Safety Officer (UXOSO), and the UXO Quality Control Specialist (UXOQCS). Site training included:

- Project summary
- Review of 2008 RI Work Plan
- Review of accident prevention plan (APP)
- Review of SOPs
- Site munitions brief
- Emergency response equipment
- Emergency procedures
- Site communications

The purpose of the training was to make sure that personnel fully understood the procedures and methods planned to perform operations at site areas, their individual duties and responsibilities, and all safety and environmental practices/procedures associated with site operations. Training and reviews of project documents were documented on individual SOP work statement acknowledgments and the APP acknowledgement.

Coordination with all personnel was vital for safe and efficient intrusive operations. The SUXOS was responsible for management of all munitions-related activities and, as the senior UXO qualified manager onsite, responsibilities also included coordination of field activities with project management, the client, and local emergency and support service providers. Before commencing any site fieldwork, the SUXOS notified Adak security/police, fire, and medical personnel, as well as other appropriate personnel/organizations per the approved 2008 RI Work Plan. The community was informed of the project schedule, and the expected impacts and bulletins were posted at the high school and all public buildings.

5.2.1.2 Geophysical Prove-Out Certification

A GPO was established on Adak by the government QA contractor, Battelle, for certification of equipment and personnel prior to DGM survey operations. The GPO was used to demonstrate that DGM equipment, DGM operators, data processing and analysis, and reacquisition equipment and personnel met project DQOs, including performance metrics, data delivery, and documentation, prior to the collection and analysis of DGM field data. The GPO consisted of buried items representing actual MEC expected to be encountered on the site, at representative depths and orientations. The quantity, location, depth, and orientation of the buried GPO items were not known to the geophysical survey and reacquisition personnel. DGM teams consisted of NAVEA geophysicists and/or USAE UXO qualified technicians that received EM-61 training from the project geophysicists during the initial site training.

The GPO geophysical surveys were conducted in accordance with the GPO work plan in the same manner and using the same equipment as the follow-on geophysical surveys for the RI, including all QC checks described in

Section 5.2.3.3. The employed DGM system for each team consisted of an EM61-MK2 time domain electromagnetic (TDEM) induction detector with an Allegro CE field data logger coupled with a Trimble R8 RTK DGPS rover. DGPS corrections were supplied by a Trimble 5700 RTK DGPS base station established on a nearby survey control point. Geonics sensor software was used for downloading and exporting TDEM data and Trimble's Geomatics Office software were used for mapping and transferring GPS data. Initial processing and field analysis was accomplished using Geosoft's Oasis Montaj software v7.0.

The DGM survey teams and the reacquisition teams deployed the EM61-MK2 in stretcher mode. During the surveys, the RTK DGPS antenna was mounted over the coil center. During reacquisition, the RTK DGPS antenna was mounted to a range pole to position the antenna directly over the target. The DGM teams configured the EM61-MK2 data loggers to record all four bottom-coil time-gate data at a 10-hertz (Hz) rate. The rover RTK DGPS output the data at a 1-Hz rate.

After the GPO survey, the DGM data were processed in the same manner as the follow-on RI DGM survey data and submitted to the Government QA Contractor, Battelle, for analysis and certification in accordance with the approved Navy-provided GPO Certification Plan.

QC procedures for GPO included GPO certification prior to beginning fieldwork, when an uncertified person was assigned to the geophysical or reacquire teams, or when new equipment was brought onsite. The GPO certification was intended to validate the ability of the system, personnel, and procedures to attain the contract required score of 0.85 probability of detection at a 90 percent confidence level.

QC personnel established an additional procedure for testing analog geophysical instruments, constructing an instrument test strip (ITS) within a portion of RR-04 near Andrew Lake The ITS consisted of appropriate inert seed items or simulants for 40-mm grenades and 81-mm and 60-mm mortars in order to conduct a daily instrument functional test of the Whites XLT® Spectrum metal detector (Whites XLT) prior to the instrument use for surface clearance. All UXO technicians processed through the ITS daily to demonstrate their ability and the instruments' capability to detect buried munitions. QC personnel monitored these daily checks, and the results were documented.

5.2.1.3 Three Phases of Control Inspections QC Checklists

The QC staff used the three phases of control inspection QC checklists in accordance with the MEC QAPP. These were used to document whether the DFWs were executed per the approved plans and procedures.

Preparatory Phase Inspection. The preparatory phase inspections were performed prior to the beginning of each DFW. The purpose of these inspections was to review the work scopes and applicable specifications. The inspections verified that the necessary resources, conditions, and controls were in place and compliant before the start of work activities. These inspections were conducted using the Preparatory Inspection Checklist.

QC of the preparatory phase inspections was accomplished by QC review of the Preparatory Inspection Checklists, with documentation recorded on QC Preparatory Phase Inspection forms.

Initial Phase Inspection. The initial phase inspections were performed for each DFW once a representative sample of the work had been completed. The purpose of these inspections was to check the preliminary work for compliance with procedures and contract specifications, verify inspection and testing requirements, establish the acceptable level of workmanship, review the minutes of the preparatory phase, and check for omissions and resolve any differences of interpretation. These inspections were conducted using the Initial Phase Inspection Checklist.

Follow-up Phase Inspection. The follow-up phase inspections were performed each week that work on a DFW was performed. The purpose of these inspections was to verify continuous compliance and level of workmanship. The Project QCM observed the same activities as under the initial inspection and made sure that any discrepancies between site practices and approved specifications were identified and resolved. Corrective actions for unsatisfactory conditions or practices were verified by the Project QCM prior to continuing work on the affected feature.

5.2.2 Site Preparation

This section describes site preparation activities for the MEC investigation, including the construction of grids and transects, debris removal and vegetation clearance, and geodetic surveys of each AOC.

5.2.2.1 Grid and Transect Construction

Data obtained from site assessment/reconnaissance and site inspection were used to specify type of munitions and AOC type, which in turn were used to determine a transect spacing (investigation pattern) appropriate for geophysical mapping during AOC characterization. Performance of the site characterization process includes field acquisition of geophysical data, processing of the geophysical data, and intrusive investigation of targeted anomalies. Identification and classification of target anomalies provide data for subsequent hazard assessment and feasibility study evaluations. The field activities used during the RI to complete site characterization for MEC include transects, grids, and expansion grids, as described in Section 4.1. Prior to the start of operations at the AOCs, USAE installed the boundary and internal survey transects and grids.

5.2.2.2 Debris Removal and Vegetation Clearance

The primary purpose for debris removal and vegetation clearance was to rid the site of metallic objects, including MEC, and vegetative materials on the ground surface that would interfere with subsequent DGM surveys. The procedures for conducting these activities are presented in SOP 1. The work consisted of visual reconnaissance and analog clearance of the surface area. MEC found during the surface clearance operations were characterized and recorded on the MEC log for the AOC, and appropriately disposed. Debris removal and vegetation clearance were performed at all AOCs requiring such work.

5.2.2.3 Geodetic Survey

Trimble real-time kinematic differential global positioning system (RTK-DGPS) was used in accordance with SOP 2 of the 2008 RI Work Plan to survey the established transects and grids in each AOC. The survey team consisted of two UXO technicians who were experienced in the use of the RTK-DGPS. These individuals established a base station at a known benchmark on Adak and then navigated to points determined by the use of the Adak Island Geographic Information System database. AOC boundaries were marked for accessibility (limits of 30 degree slopes as measured by an inclinometer and per Section 2.3 of SOP 2, and exception areas such as standing water, creeks, and installed search grid corners). During the location surveys and follow-on DGM (see Section 5.2.3.3), the project geophysicist verified inaccessibility areas, which were in turn confirmed by the Government QA Contractor.

The survey team implemented MEC avoidance procedures by visual and analog metal detector (Whites XLT) means to detect and avoid metallic anomalies when transiting to/from and during the boundary survey of transects and grids. Avoidance techniques were used for all movement throughout the site to minimize or eliminate contact with possible surface MEC or MPPEH. Prior to installing grid and boundary markers, the locations were checked with the Whites XLT to confirm subsurface anomalies were not present.

5.2.3 Data Acquisition

This section describes the data collection activities of the MEC investigation, including site reconnaissance, instrument-aided visual reconnaissance, observation of erosional features that might contribute to migration of MEC, and geophysical data collection. The QC requirements for DFWs associated with data acquisition are listed in Table 5-2.

5.2.3.1 Site Reconnaissance and Instrument-aided Visual Inspection

General site reconnaissance, or site assessment, activities were conducted in each AOC to gather data required for the operational planning of site inspection and site characterization field activities.

The procedures for completing the reconnaissance activities were listed in Section 5 of SOP 1 and consisted of examination for visual evidence of past munitions use or disposal including burn pits, burial pits, craters, depressions, stressed vegetation, or munitions-related artifacts. If such items were observed, the area would then be evaluated and checked for possible buried metallic anomalies using the Whites XLT. Areas containing multiple or clustered subsurface metallic anomalies were examined, recorded in the field notes, photographed, and located using RTK-DGPS. MEC found during the instrument-aided reconnaissance were characterized and recorded on the MEC log and were appropriately disposed of.

5.2.3.2 Observation of Physical Features Indicative of Erosion or Site Instability

The potential for migration of MEC was assessed through visual reconnaissance of the designated AOCs (in accordance with the MEC QAPP) for evidence of possible erosion and/or slope instability.

The procedures for conducting these observations were outlined in SOP 9 of the 2008 RI Work Plan. Possible features of particular interest included:

- Areas where steep slopes or outwash gullies were present
- Road cuts that crosscut moderate to steep slopes
- Areas where known debris burial occurred in the past, which could erode due to surface water, mass wasting, or wave action
- Areas adjacent to high-wave-action beaches
- Areas below cliffs where rock-fall has occurred
- Areas with surface water features (e.g., streams, seeps)
- Channels and any location where “channeled” water flow may have occurred
- Areas above 1,000 feet in elevation where surface elevation discontinuities existed

5.2.3.3 Geophysical Data Collection

USAE and NAVEA DGM teams performed the geophysical data collection and initial processing for the 2008 OU B-2 RI during the period of June 19 through July 16, 2008. The employed DGM system for each team consisted of an EM61-MK2 TDEM induction detector with an Allegro CE field data logger coupled with a Trimble R8 RTK DGPS rover. DGPS corrections were supplied by a Trimble 5700 RTK DGPS base station established on a nearby survey control point. Geonics sensor software was used for downloading and exporting TDEM data, and Trimble’s Geomatics Office software was used for mapping and transferring GPS data. Initial processing and field analysis was accomplished using Geosoft’s Oasis Montaj software v7.0.

The DGM teams deployed the EM61-MK2 in stretcher mode for all survey work and in wheeled mode during anomaly reacquisition. During the surveys, the RTK DGPS antenna was mounted over the coil center. During reacquisition, the RTK DGPS antenna was mounted to a range pole to position the antenna directly over the target. The DGM teams configured the EM61-MK2 data loggers to record all four bottom-coil time-gate data at a 10-hertz (Hz) rate. The rover RTK DGPS output the data at a 1-Hz rate. Quality control tests described in Section 5.2.6.6 were regularly conducted by each DGM team.

RTK-DGPS grid corner and transect coordinate data were preloaded into DGM instrumentation and marked in the field by the USAE survey team. In AOCs requiring transect DGM surveys, the DGM teams collected data in sets of parallel survey lines spaced at a variety of distances depending on the CSM for the AOC. Grid-based DGM surveys were conducted with comprehensive coverage along lines spaced 1.5 feet apart with one member of the DGM team marking the lanes with plastic pin flags every 15 to 20 feet behind the survey crew to make sure there was adequate sensor overlap on returning lines. Areas of the site that remained inaccessible to the DGM team (e.g., obstacles, slopes greater than 30 degrees, and pockets of standing water deeper than 6 inches) were photographed and documented in the positioned sensor data maps, on survey data forms, and/or in the field log books. The DGM teams attempted to extend the EM61-MK2 sensor over areas of deep standing water to provide coverage that was as complete as possible.

The DGM Team Leaders submitted raw geophysical and DGPS instrument test and survey data, digital field log books, and the RTK DGPS data logger at the end of each survey day for data processing and analysis and anomaly identification.

5.2.4 Geophysical Anomaly Identification

This section describes the processing, analysis, and management activities for DGM data and geophysical anomaly identification.

5.2.4.1 DGM Data Processing

Offsite NAEVA and USAE geophysicists processed DGM instrument tests and survey data in accordance with procedures identified in the MEC QAPP and 2008 RI Work Plan and in accordance with SOP 3. DGM data were processed using Geosoft's Oasis Montaj software v7.0 and involved correcting the data for instrument drift and geophysical system latency. Geosoft's non-linear 100-point rolling median drift filter was applied to the data to correct for instrument drift and to reduce the level of noise in the data. Additionally, hand-filtering was applied if necessary to further reduce the effects of noise in the data. Special care was taken to resolve true target responses when more aggressive filtering was used.

Latency corrections were also applied to the DGM data to adjust for the delay between detection and recording in the geophysical system. The applied correction was based on latency tests performed along with each day's DGM survey.

5.2.4.2 DGM Data Analysis

NAEVA and USAE geophysicists used Geosoft's Oasis Montaj software v7.0 and the UX-Detect module to analyze the DGM instrument tests and survey data. Data analysis and target selection were based on the results of the GPO certification. An original selection threshold of 3 millivolts (mV) was planned for the 2008 RI based on results from the GPO certification grid and transect. This threshold of 3 mV in Channel 1 was later changed to 4.3 mV (see Appendix C10). This increase was requested by USAE, Navy QA determined the highest threshold (4.3 mV) that would still pass the GPO certification metrics, and the change was accepted by all parties. Use of the new threshold was implemented on July 24, 2008. Meeting notes documenting the reasons for this increase are provided in Appendix C4

Target anomalies were initially picked using the automated UX-Detect Blakely method on leveled EM61-MK2 data from the first time gate. Each of the selected anomalies was analyzed by the Project Geophysicist and evaluated as to its validity and position. Targets found to be invalid or incorrectly located were removed or relocated. Additionally, anomalies that were not selected by UX-Detect, yet deemed to represent a potential MEC target, were manually selected. The Excel target data spreadsheets and Oasis target maps were then exported and given to the UXOQCS, who reviewed the DGM data and anomaly selections. Upon review and acceptance of the data and anomaly selections by the UXOQCS, all final processed data (Oasis.xyz files), target maps (.pdf files), and target dig lists (.xls spreadsheets) were submitted to the Government QA contractor, with an informational e-mail documenting which data were submitted for review and approval.

5.2.4.3 DGM Data Management

All DGM data were archived on a portable hard drive by the Data Manager and stored in a fireproof safe. Raw and processed DGM data are provided in Appendix C9 (included on a DVD attached to this report).

5.2.5 Anomaly Resolution

This section describes MEC field activities associated with the resolution of target anomalies identified in the geophysical surveys. Anomaly resolution for DGM-identified targets includes reacquisition of the anomalies on the target lists, excavation of the targets, and validation of the excavation activities. This section also describes the resolution of anomalies in mag and dig operations. All anomaly resolution activities include MEC disposal and management of MPPEH.

5.2.5.1 Anomaly Reacquisition

After QC and QA review and concurrence, target lists were provided to the Reacquisition Team Leader (TL) to mark targets to be excavated. Target reacquisition teams utilized RTK DGPS to locate target locations to an accuracy of 0.25 foot or less. The reacquisition team used an EM61-MK2 to refine the target location and marked the location for investigation with a pin flag. If no target was found at the pin flag location, the search extended to a 2.5-foot radius of this position. If no anomaly was located within the search radius, it was recorded on the target list as a “no find.” “No finds” in turn triggered a causal analysis, and the data were reevaluated by the Site Geophysicist.

5.2.5.2 Anomaly Excavation

An exclusion zone (EZ) for each AOC was established in accordance with the approved Explosives Safety Submission (ESS) and the RI Work Plan. The Emergency Medical Technician (EMT) was typically stationed at the main road gate (access for AOCs on the north side of Andrew Lake) and on the access road just east of SA93-02 (for access to AOCs on the south side of Andrew Lake). The EMT monitored access to make sure that only essential personnel entered the EZ. Non-essential personnel and visitors were stopped at the gate and the UXOSO was notified. The UXOSO provided UXO escort for the Navy Technical Representative (NTR) and all visitors with the exception of Government QA personnel. Government QA personnel were designated essential personnel and provided their own UXO escort.

The SUXOS and UXOSO monitored operations at each AOC to make sure appropriate team separation distance (TSD) was maintained at all times. TSDs were AOC-specific and based on the munition with the greatest fragmentation distance (MGFD) that was either suspected or known to be present based on archival records or previous investigations.

Intrusive teams consisted of a TL and two to six UXO technicians. The intrusive teams were provided personal digital assistants (PDAs) with pre-loaded blank dig packages containing the geophysical anomalies to be investigated. The TL recorded recovered anomaly data on a PDA using pull-down menus. The PDA menus were developed and customized to make sure that data recorded were consistent with the requirements of the Navy Electronic Data Delivery System (NEDDS) for inclusion in the Adak database. The TL completed all fields in accordance with the pull-down menu instructions. At the end of each day, the TL turned the PDA over to the SUXOS or, later, the data manager, who checked the data for completeness and accuracy. The data were downloaded to the project database; then uploaded to the PDA with the next day’s dig packages and anomaly coordinate data.

The maximum depth of investigation for the 2008 RI was 2 feet below the top of the mineral soil. This clearance depth was specified in Section 5.6 of the approved 2008 RI Work Plan, which states:

> “The maximum depth of investigation for this project is 2 feet below the top of the mineral soil. If anomalies are present below this depth, that information will be recorded on the appropriate field forms and excavation will be discontinued.”

The clearance depth is also based upon the following supporting factors:

- The 2-foot clearance depth is consistent with the Adak Island OU B ESHA Methodology, Table C-1 (Adak-Specific Future Land Use Matrix) for recreation and wildlife management future land uses.
- The 2-foot clearance depth is consistent with what is specified in the OU B-1 ROD, Section 9.3, which states that a 2-foot *minimum* required clearance depth is required for reasonably likely future land uses of recreational and wildlife areas of Adak.
- The 2-foot clearance depth is consistent with EPA’s September 30, 2004, letter, which states, “In June 2000, the formal dispute process was resolved with the approval by EPA and ADEC of the RI/FS Work Plan for Operable Unit B,” and “…site-specific determinations for clearance depths for wildlife areas were further refined to 2 feet bgs clearance for wildlife and remote areas to simplify administration.”

- During 2008, 5percent of MEC was found at the surface, 88 percent of MEC was found between 0 and 1 foot bgs, and 7 percent was found at 1 to 2 feet bgs. Only two anomalies were identified at depths greater than 2 feet bgs and these were left uninvestigated.
- Of the MEC recovered from OU B-2 to date, only 8.4 percent were discovered below 1 foot bgs. Almost 23 percent of the MEC items were recovered from the surface, with another 44.3 percent encountered between the surface and 0.5 foot bgs. An additional 24.3 percent of these MEC were located between 0.5 and 1 foot bgs.

The specific intrusive investigation procedures are outlined below:

- Each anomaly was investigated by locating the boundaries with a Whites XLT and excavating gently to one side of the target. A shovel was used to excavate to within 12 inches of the anomaly. The final 12 inches of cover were removed using a small trowel or gloved hand.
- Munitions debris was collected at designated locations within the work area for transport to the storage area and flashing, pending shipment off-island for demilitarization.
- If the anomaly was determined to be MEC, the item was recorded, marked, and the SUXOS was notified. Fuzed MEC or MEC otherwise determined to be unsafe to move were left in place for daily blow in place (BIP). Unfuzed MEC determined to be safe to move were moved to a common location for consolidated detonation. After BIP and controlled detonation activities, the surrounding blast radius was inspected for debris and MPPEH resulting from the detonation. MEC disposal operations are further discussed in Section 5.2.5.5.
- Upon completion of the excavation and the required QC checks, the hole was marked and left open for QA checks. Once QA completed a transect or grid, the holes were backfilled to the original ground surface.

5.2.5.3 Target Validation Check

After excavation of an anomaly, the TL inspected the excavation both visually and with the Whites XLT to make sure that all anomalies present within the required dig depth had been removed.

5.2.5.4 Analog Operations

Anomaly investigations for analog clearance of the craters at ALDA-01 were performed as a mag and dig operation in accordance with the instrument-aided visual inspection procedures specified in Section 5.2.3.1

5.2.5.5 MEC Disposal

MEC found during intrusive investigation was managed in accordance with waste handling procedures in the EPP/WMP included in the 2008 RI Work Plan (Tetra Tech, 2008). MEC was either blown up in place daily if determined to be unsafe to move or detonated along with additional MEC in consolidated detonations if safe to move. MEC was stored in the onsite MEC magazine for consolidated detonation, and demolition was performed weekly. UXO personnel detonated MEC and other munitions items using jet perforators to make sure no explosives or reactive material remained prior to flashing and final disposal offsite. All demolition took place at the AOC, as required. Consolidated shots of items in the MEC magazine were performed in AOC OB/OD-01.

During site setup and training, a notice was placed on the Adak High School OE Awareness bulletin board outlining areas for MEC operations. The notice stated that demolition operations may be ongoing daily. Prior to disposal operations, all technicians assigned to or working with disposal teams attended a site-specific orientation to review MEC disposal and emergency response procedures.

5.2.5.6 Munitions Debris Management

MPPEH recovered during investigation activities was inspected, and disposed of in accordance with the EPP/WMP included in the 2008 RI Work Plan and with NAVSEA OP 5 (U.S. Navy, 2007). Items determined by the 5X inspection process to be free of explosive hazard were stored in 55-gallon, open-top, Department of Transportation (DOT)-approved drums with locking lids. These items were treated using a thermal flashing unit (TFU) in accordance with the 2008 RI Work Plan to make sure residual energetic materials were not present and to certify/verify that the items were safe to move to an offsite recycler. If it could not be determined whether an item had explosives or if it was closed to visual inspection, it was vented following the demolition procedures in the MEC QAPP (SOP 7) using a jet perforator (shape charge) pending final dual certification and flashing of all material.

The procedures from SOP 6 for flashing operation are summarized as follows:

- All operators wore the proper safety equipment, including Level D work clothing, welder's gloves, aprons, safety glasses, and a hard hat with a full-face shield.
- Operators spread approximately 30 pounds of MPPEH 5X evenly over the burn screen.
- The operators then moved to a designated safe area outside the 50-foot EZ.
- The operators waited approximately 6 minutes for the TFU to reach operational temperature. They monitored the unit's temperature with a heat gun in accordance with the manufacturer's operation procedures.
- Once the unit reached operating temperature (between 600 and 800˚F), the operators allowed the unit to burn for 8 minutes, with a total processing time of approximately 14 minutes.
- Once the unit cooled, the flashed material was checked with EXPRAY to verify that explosive residue had been removed, and the material was loaded into barrels and secured.

5.2.6 Product Quality Control

The sampling protocols contained within the Military Standard (MILSTD) 1916 were used for product QC. Table 5-3 summarizes the operations/attributes that were assessed using acceptance sampling.

In addition, the approved 2008 RI Work Plan and MEC QAPP outlined the QC management plan for the 2008 RI. The QC staff implemented the plan through a series of periodically scheduled inspections and audits prescribed in the MEC QAPP, WS #35, and summarized in Table 5-2. The inspections and audits were documented on QC surveillance checklists, SOP checklists, the QC field logbooks, and daily and weekly QC reports.

The QC processes followed during the course of the 2008 MEC field work were consistent with those used to prepare AOC certification reports for review by the AOC certification board. However, since the 2008 RI was an investigation rather than a remedial action, no AOC certification reports have been developed.

5.2.6.1 Quality Control Data

The QC data include the following:

1. The logbooks maintained by the UXOQCS and the Project QCM
2. All of the QC daily reports prepared by the UXOQCS
3. The QC summary reports prepared by the Project QCM; the Weekly QC reports; and the three-phase QC surveillance forms for each DFW

5.2.6.2 Daily and Weekly Quality Control Meetings\Reports

The UXOQCS maintained a logbook of activities, completed the QC surveillance forms as required, and provided the QCM with a daily QC report summarizing the daily QC activities. The QC surveillance forms and daily reports were added into the weekly QC report prepared by the QCM and provided to the SM.

5.2.6.3 Operations Quality Control Summary

The MEC QAPP provided the directive to the project QC staff for ensuring the project requirements were met. The MEC QAPP lists the QC surveillance checks for each DFW and the frequency of those checks using the three-phase inspection process. The QC surveillance process included review of data and dig results with questionable targets revisited.

TABLE 5-3
Product QC Requirements Based on MILSTD 1916

Operation/Attribute	Sample Unit	Lot Definition	Sampling Protocol	Acceptance Criteria	Corrective Action	Responsibility	SOP
Geophysical Survey Data Collection	1 m x 20 m transects	All transect segments within an AOC completed by the same geophysical team	VL (III)CL (A)	The allowable variance for investigation will not exceed 2% of the accessible area surveyed. If the total area of the gaps exceed this percentage, data will be recollected in those gaps if possible	Analysis of cause of failure; possible rework	Project geophysicist/PM	SOP 2
Geophysical Data Analysis/Anomaly Detection and Identification	Not applicable	All transect segments within an AOC completed by same data geophysicist	VL (III)CL (A)	All additional anomalies identified by QC are false positives	Analysis of cause of failure; possible rework	Project geophysicist/PM	SOP 3
Anomaly Excavation/ Anomaly Source Removal	Completed excavation (anomaly source removed)	All excavations within an AOC completed by same UXO team	VL (III)CL (A)	All excavations free of metallic items or material	Analysis of cause of failure; possible rework	Senior UXO Supervisor/PM	SOP 4 SOP 5

5.2.6.4 Quality Assessment Audits

Two ADEC audits were performed during the 2008 field season, the first in June and the second in August. The purpose of the audits was to assess compliance with the 2008 RI Work Plan. A Naval Ordnance Safety and Security Activity (NOSSA) audit was performed on August 1, 2008. The purpose of the NOSSA audit was to assess compliance with applicable explosives safety, environmental, and related requirements. The NOSSA auditors reviewed the project documentation and observed selected field operations.

5.2.6.5 Deviations from the Project Plans

Proposed changes to plans and procedures as a result of unanticipated field conditions or errors and omissions in the plans or procedures were documented and requested using a FCR form. The completed FCRs were reviewed by the Project QCM and the project management staff, entered onto the FCR log, and forwarded to the NTR for the Navy's review and approval.

5.2.6.6 DGM Systems Quality Control

Geophysical data quality was a function of data management and the overall process from data collection through processing and interpretation. Data quality was verified through (1) the GPO certification process for the equipment and (2) the operators' ability to meet the project's DQOs and through the implementation of the three-phase control process outlined in the MEC QAPP. Equipment QC checks were performed at the beginning and end of each survey day. The DGM team set up the equipment and performed the tests described below. Prior to collecting data for any of the tests, the EM61-MK2 was warmed up for a minimum period of 5 minutes.

The QC staff used the MEC QAPP WS #35 to verify that the operating procedures outlined in the SOP were followed throughout the conduct of this project. Appendix C3 contains the instrument test results.

Daily RTK-DGPS Reoccupation Tests. Each day the RTK-DGPS base station was set up, the USAE team checked the accuracy by placing the rover DGPS over the second survey control monument (GPO Check Point). All reoccupation tests met the requirement for reoccupation accuracy (with 0.25 feet) established in WS#22 of the MEC QAPP.

Static/Standard Tests. Prior to and following geophysical data collection each day, sensor data were recorded in a stationary mode for approximately 3 minutes. The purpose of this test was to aid in identifying equipment problems and to determine instrument drift and instrument response. Data were first recorded for 1 minute with no object near the sensor to record background readings and to document any drift in the readings. A metal standard (i.e., large industrial screw embedded in a fiberglass rod) was then placed in exactly the same position relative to the sensors, and readings were continued for 1 minute. The standard was then removed, and readings were continued for an additional 1 minute to document continued stability. Instrument readings of the standard were checked to make sure they were within ±20 percent of the average of all readings taken.

Cable Shake Test. Cable shake tests were performed each morning during the static/standard tests to check for shorts or other issues at the cable connections that might result in data spikes or drop-outs. No spikes or drop-outs were observed in any of the cable shake tests.

Six Line Test. Prior to GPO data collection, a Six Line Test was performed with the EM61-MK2 for both data collection teams. The purpose of the Six Line Tests was to document latency and positional accuracy. The Six Line Tests consisted of one line 50 feet in length, located north of the GPO grid and west of the calibration grid. The ends and center point of the line were marked with polyvinyl chloride (PVC) pin flags and recorded with the RTK-DGPS. Data were collected during six passes over this line. The first two passes were performed at normal walking speed with no metallic items placed on the line. The first line was walked east to west, the second west to east. The next two passes were conducted at normal walking speed with a metal standard (10-inch nail) placed at the 25-foot mark, first east to west, and then west to east. The fifth pass was performed while walking west at a fast pace with the standard placed at the 25-foot mark. This is used to simulate data collection downhill where the instrument operators could be walking faster than normal. The final pass was performed while walking at a slow pace with the standard placed at the 25-foot mark. This test was used to simulate data collection uphill where the instrument operators will be walking slower than normal.

Profile plot comparisons were prepared showing the Six Line Test results for both data collection teams. Both data sets exhibited good positional repeatability. Response to the standard is lower for the fast pace line and higher for the slow pace line, because of the altered likelihood of sampling directly over the maximum response for the standard.

Latency Line Test. Latency Line Tests were performed twice daily to adjust the latency correction established using the Six Line Test. During the GPO, the Six Line Test location was used to collect two lines of data in opposite directions with the metal standard located at the 25-foot mark. This test was performed before and after field data collection each day. The lines were compared for consistent response as well as to document the appropriate latency correction.

Repeat Line Test. Repeat data were collected to document geophysical data repeatability. The last line of the GPO Grid was used for the Repeat Line Test following all data collection sessions. As an additional check of the latency correction, repeat data were collected in the opposite direction from the original survey direction. The positional and geophysical data repeatability results are acceptable for the GPO survey.

5.2.6.7 Reacquisition Quality Control

During target reacquisition activities, the EM61-MK2 was used to refine the flagged target locations. The refined target locations and anomaly amplitudes were compared to the picked target locations and original mV readings for any discrepancies. Target reacquire comparisons are provided in Appendix C5.

5.2.6.8 MEC Investigation Quality Control

All intrusive result data were collected on Trimble GeoXH PDAs running ESRI ArcPad version 7.1. Upon QA approval of target dig lists, the USAE GIS Manager imported the target dig lists into ESRI ArcPad.axf files that were sent via file transfer protocol (ftp) to the onsite Data Manager and uploaded to the Trimble GeoXH. During intrusive investigations, the UXO TLs then entered intrusive data on the GeoXH directly into the pre-approved data collection fields for each pre-loaded anomaly. These data were downloaded at the end of each day by the SUXOS or the Data Manager.

The SUXOS or Data Manager reviewed the intrusive results with each intrusive TL and uploaded the reviewed intrusive results to the USAE ftp site. The USAE GIS Manager then uploaded the data to the master GIS database daily. Upon intrusive completion of a grid, the SUXOS or Data Manager checked the database for any incomplete or erroneous information and consulted with the SUXOS or TLs to correct the database information, if needed. Once the SUXOS or Data Manager had determined that all required data fields were filled in and correct, the completed database was then submitted to the offsite geophysicist for anomaly review. The offsite geophysicist then reviewed all intrusive results for any discrepancies between initial picked mV readings, reacquired mV readings, and intrusive results to determine if the size, shape, weight, and depth of the recovered anomaly corresponded with the electrical signature of the mapped anomaly.

If a discrepancy existed, the offsite geophysicist would submit an Intrusive Results Review form to the SUXOS to re-examine any noted anomalies. The SUXOS would then provide the list of targets to be re-examined to the TL and the reacquire team, if necessary. The targets would then be re-investigated intrusively and all results reported. If no discrepancies existed or after all anomaly results were deemed complete and satisfactory, the data were submitted to the QCM for final review. The QCM generated a QC report for each completed grid and delivered the QC report, the final target map, and final dig list to the Government QC contractor. The Government QA contractor performed oversight activities and documented the findings in a QC certification report. These QA reports are included in Appendix C13.

5.2.6.9 Root Cause Analysis

Whenever a failure occurred, a root cause analysis (RCA) was conducted to determine if the failure was the result of the procedures, equipment, personnel, environment, or some combination thereof. The continuous improvement program involved the UXOQCS soliciting project personnel for lessons learned and submitting them to the field management staff for review and recommendation to the Program QC Manager (PQCM) for review and submission to the Program Manager. The Program Manager would in turn review and approve them for submission to the Navy in the form of an FCR for review and approval.

The QCM performed an RCA for three failures, which were attached to deficiency notices, posted to the deficiency notice log, and provided to the SM for rework. After rework, the deficiencies underwent a QC re-inspection and all three passed.

5.2.7 Site Restoration

This section describes the site restoration activities for the MEC investigation.

5.2.7.1 Backfilling Excavations

After the completion of excavation activities and quality control inspections of excavation sites, each excavation location was backfilled and compacted to the original ground surface level.

5.2.7.2 Policing Area

During the RI investigations, cultural and range-related debris, as well as munitions debris, remaining on the ground surface was removed from each AOC. All debris was disposed of after inspection to determine that there was no associated explosive risk.

5.2.8 Reporting Results

The tasks associated with the Reporting Results DFW are not detailed in the MEC QAPP, but have been assumed to include preparation and review of the forms, log books, and checklists generated by the preceding DFWs, presentation of interim results to the EPA and ADEC during weekly QC meeting and periodic status meetings, and compilation of results into this RI Report.

5.3 2008 MEC Investigation Results and Recommendations

The general goals for the 2008 RI MEC investigation were to:

- Define the extent of MEC contamination, identify areas where higher concentrations of MEC are present, and determine the potential for transport/migration of MEC from source areas.
- Provide data to support the hazard evaluation and FS analyses for determining remedial alternatives or NOFA for the AOCs.

The areas of interest for the 2008 MEC investigation were selected based on historical operations and training activity information and previously-obtained geophysical and intrusive investigation results. The scope of the 2008 MEC investigation conducted at each AOC was determined by review of existing site information in the context of Level 2 assessment methodology for the designated AOC type (see Section 4.2).

The 2008 field work was conducted in accordance with the DFWs detailed in the MEC QAPP or with modifications approved through the FCR process. Table 5-4 lists the DFWs for MEC and provides a review of results and recommendations. In addition, this section provides a summary of the results for the principal 2008 MEC data gathering and QC activities.

5.3.1 GPO Certification

The DGM and reacquisition teams and the geophysical systems used for the RI were certified by the Government QA Contractor, Battelle, in accordance with the approved Navy-provided GPO Certification Plan to be used for both DGM surveying and target reacquisition. Each team detected 97 percent of the GPO targets. All large and medium targets were detected, and each team missed two small targets. With the exception of across-track sample density, all project DQOs were met.

TABLE 5-4
2008 MEC Investigation Findings and Recommendations by DFW

DFW	Task	Documentation Location	QC Documentation Location	Issues	Results	Recommendations
Certification/ Training	Training Requirements	5.2.1.1, Appendix C2	Appendix C2	Update CPR training requirements (FCR-9)	Completed as planned	None
	Document Review	Appendix C2	Appendix C1	None	Completed as planned	None
	GPO Certification	5.2.1.2, Appendix C5	Appendix C5	Waiver for GPO DGM re-certification of personnel following redeployment to Adak (FCR-18)	Completed as planned	None
	3 Phase Inspections	5.2.13, Appendix C1	Appendix C1	None	Completed as planned	None
Site Preparation	Grid/Transect Construction	5.2.2.1	Appendix C1	None	Completed as planned	None
	Vegetation Removal/ Debris Removal	5.2.2.2, Appendix A, Appendix C3	Appendix C1	Adjust team sizes in SOP 1 and 11 (FCR-4 and FCR-5)	Completed as planned	None
	Geodetic Survey	5.2.2.3, Appendix C9	Appendix C1	None	Completed as planned	None
Data Acquisition	Site Reconnaissance and Instrument-aided Visual Inspection	5.2.3.1	Appendix C1	Limited documentation of accessibility evaluations at C1-01 and SA93-01	Completed as planned	None, informal documentation indicates slopes were too steep to allow DGM surveys
	Observation of Features Indicative of Erosion or Site Instability	5.2.3.2	Appendix C1	None	Completed as planned	None

TABLE 5-4
2008 MEC Investigation Findings and Recommendations by DFW

DFW	Task	Documentation Location	QC Documentation Location	Issues	Results	Recommendations
	Geophysical Data Collection	5.2.3.3, Section 5.4.1, Appendix C11	Appendix C1	Move transect locations in ALSW-01 (FCR-1), move grid location in ALSW-01 (FCR-2), revise transect type in MI-03 (FCR-11), 50% survey along lanes in MAG-01 (FCR-15), DGM characterization west of spillway at ALSW-01 (FCR-16), use of step-out transects at MI-01 (FCR 17)	Limited survey at MAG-01 increased uncertainty about possible presence of MEC in southern portion of AOC	None—no evidence of storage magazine or MEC found at MAG-01
Geophysical Anomaly Identification	Data Processing	5.2.4.1	Appendix C1		Completed as planned	None
	Data Analysis	5.4.4.2, Appendix C10	Appendix C1	Original selection criteria for targets changed from 3 mV to 4.3 mV	Completed as planned	None
	Data Management	5.2.4.3, Appendix C9	Appendix C1		Completed as planned	None
Anomaly Resolution	Anomaly Reacquisition	5.2.5.1	Appendix C1		Completed as planned	None
	Anomaly Excavation	5.2.5.2	Appendix C1	Adjust team size in SOP 5 (FCR-6), limited excavation of anomalies in ALSW-01 grid (FCR-12); limited excavation of anomalies on top and sidewalls of ALSW-01 (FCR-14)	Limited excavation at ALSW-01 increased uncertainty about possible MEC in subsurface at AOC	None – Data gathered at ALSW-01 sufficient to make determination about need for evaluation in FS
	Target Validation Check	5.2.5.3	Appendix C1		Completed as planned	None
	Analog Operations	5.2.5.4	Appendix C1		Completed as planned	None
	MEC Disposal	5.2.5.5	Appendix C1	Modify Explosive Demolition SOP-07 paragraph 4.1, revise horn requirements (FCR-8)	Completed as planned	None
	Munitions Debris Management	5.2.5.6	Appendix C1		Completed	None

TABLE 5-4
2008 MEC Investigation Findings and Recommendations by DFW

DFW	Task	Documentation Location	QC Documentation Location	Issues	Results	Recommendations
Product QC	Tier 3 QC Process	5.2.6, Appendix C1, Appendix C3, Appendix C5, Appendix C6, Appendix C10	Appendix C1 Appendix C13	QC reports (Appendix C13) identified possible discrepancies in work reported versus work required at several AOCs, and misidentification of items and erroneous locations of items location information in data provided for several AOCs. Data review conducted as part of MEC data evaluation indicates that discrepancies were resolved and errors were corrected in final data.	QC reports were not updated to reflect final data	Update QC Reports
Site Restoration	Backfill (as necessary)	5.2.7.1	Not applicable		Completed as planned	None
	Police Area (remove debris	5.2.7.2	Not applicable		Completed as planned	None
Reporting Results	Presentation of Results	5.2.8, Appendix A, Appendix B, Appendix C5, Appendix C8, Appendix C11	Not applicable		Completed as planned	None

Analysis of the sample density coverage from the GPO DGM surveys led the project team to reduce the survey line spacing from 2.5 to 1.5 feet to make sure the DQO of less than 2.0 percent across-track data gaps would be consistently met for the RI DGM surveys. The complete GPO Summary Report is included in Appendix C5. GPO certification data is provided in Appendix C14.

5.3.2 Site Preparation

Site preparation activities including grid/transect construction, vegetation and debris removal, and geodetic surveys, were completed either as planned, or as modified by the FCR process. Information about changes to site preparation activities at individual AOCs is presented in the AOC-specific results in Section 5.6.1.

5.3.3 Site Reconnaissance and Instrument-Aided Visual Inspection

Site reconnaissance was used to determine whether specified areas adjacent to the target/impact areas at C1-01 and SA93-01 were accessible for DGM survey. Field documentation (map notations and photographs) for the accessibility surveys is provided in Appendices B12 (SA93-01) and B17 (C1-01).

Instrument-aided visual inspections to characterize site conditions and establish whether additional assessment was needed were conducted at the following AOCs:

- MAG-01
- MI-03
- RR-01
- RR-02
- RR-04
- SA-01
- SA93-02
- SA93-04

The inspections were conducted in accordance with the DFW. The results, conclusions, and recommendations for site reconnaissance and instrument-aided visual inspections are described in the AOC-specific results in Section 5.6.1. Copies of the inspection reports, including maps and photographs, are included in Appendix A.

5.3.4 Reconnaissance for Features Indicative of Erosion or Site Instability

Reconnaissance for physical features indicative of erosion or site instability was conducted at the following AOCs:

- C1-01
- MI-02
- MI-03
- RR-01
- RR-02
- SA93-01
- SA93-02

The reconnaissance activities were conducted in accordance with the DFW. The results, conclusions, and recommendations for the surveys are described in the AOC-specific results in Section 5.6.1. Copies of the reconnaissance reports, including maps and photographs, are included in Appendix A.

5.3.5 Geophysical Anomaly Identification and Anomaly Resolution

An EM61-MK2, deployed in stretcher mode, positioned with a RTK DGPS, was used to collect signatures of subsurface electrically conductive objects. The positioned EM61-MK2 data were processed and analyzed to select subsurface anomalies that had the potential of being MEC. Intrusive operations identified each selected anomaly to support the characterization of each AOC.

DGM surveys were conducted at the following AOCs:

- ALSW-01
- HG-01
- MI-01
- MI-02
- MI-03
- RR-01
- RR-02
- RR-04
- SA-01
- SA93-01
- SA93-03

5.3.5.1 DGM Quality Analysis

To verify the DGM systems (sensor, positioning, and operators) were meeting the project DQOs, each system was certified at a GPO grid and transect, established by the Government's QA contractor. GPO data were collected, transferred, processed, analyzed, and delivered to the QA contractor for an independent certification. All equipment and operators were successfully certified. The GPO Letter Report and the certifications issued by the QA contractor are provided in Appendix C.

Other quality control tests included morning RTK DGPS reoccupation tests at a known point, daily morning and afternoon static tests, morning and afternoon latency tests, and repeat tests of production data. All daily DGM QC test results are provided in Appendix C.

The raw and processed DGM data were posted to the project SharePoint site, including all QC test results. DGM data were reviewed by USAE's Project Geophysicist and, when complete, they were delivered to USAE's UXOQCS for delivery to the QA contractor for their review and approval. If the QA contractor identified any additional anomalies for investigation, they were added to the intrusive investigation list.

The reacquisition teams used the same geophysical instruments used to collect the DGM data to refine each anomaly selected for intrusive investigation. This, coupled with the high accuracy RTK DGPS used to relocate processed anomaly locations, helped ensure that the anomaly selected for investigation actually was investigated. The reacquisition results are provided in Appendix C.

USAE reviewed all reacquire and intrusive results for this project. This included an assessment of the reacquire peak signatures and location offsets, and a 100 percent check of the intrusive results. Particular attention was paid to anomalies reported as "no finds." The reacquisition results were reviewed to see if the anomaly source was identified as "peak off-transect." This occurrence was a result when large conductive objects were surveyed (e.g., utility pole anchors, old buildings) close enough to produce a reportable EM signature yet outside the investigation search radius. Also, if during reacquire, no detectable anomaly signature could be located in a 2.5-foot radius from the target picked coordinates, it was identified as a reacquire "target below threshold" and the original anomaly location was flagged for intrusive investigation. This occurred primarily for small amplitude signatures that were near the system noise floor. Early in the 2008 field season, it was identified that wet grass coming in contact with the EM61-MK2 coil periodically produced sufficient noise to be selected as potential anomalies at the low investigation threshold approved from the GPO. Following an RCA, the corrective action that was approved resulted in a devegetation team working in conjunction with and in advance of each DGM team to clear high grass. “No finds” attributed to wet grass interaction with the EM61-MK2 coil are included in the reacquisition results shown in Appendix C. “No finds” also occurred due to occasional multiple peak selection on a single anomaly source. These duplicate anomalies are reported in the target database as “same as” the target number that was identified in the intrusive investigation. All remaining “no finds” were checked to a 2.5-foot radius from the reacquire position, and a 2-foot hole was intrusively investigated at the flagged location to verify the absence of any anomaly. Following the intrusive results review, the Project Geophysicist issued an Intrusive Results Review form indicating that he either concurred with the intrusive results, or identified which anomalies were selected for reinvestigation. These forms were provided to USAE’s UXOQCS and are included in Appendix C. Re-investigation of the selected “no finds” resulted in only minor changes to the final intrusive results with no MEC or MEC-sized anomalies discovered during any recheck. Anomaly rechecks and the final intrusive results are provided in Appendix C.

All reacquisition and intrusive results were provided to the QA contractor for their review and acceptance. This combination of comprehensive DGM quality analysis and independent QA assessment substantiates the confidence in the DGM characterization results.

5.3.5.2 Characterization Assessment

While high-quality DGM for anomaly detection was obtained over the majority of the project site, several AOCs were problematic for complete DGM characterization. Safe access or safe intrusive investigations were limited in some areas by slopes greater than 30 degrees, rivers, creeks, and large pockets of standing water. These are documented in the Transect Deviation Checklists provided in Appendix C.

Another limitation included AOCs, or portions of AOCs, with high anomaly densities. ALSW-01 is an example of one of these high anomaly density areas. The sea wall is constructed of cobble stone and reinforcing metal. The geophysical survey results of this area showed a nearly continuous anomalous response, indicating the presence of an extremely high number of metallic objects. An FCR was approved to intrusively investigate 5 percent of the ALSW01 transect anomalies versus 100 percent, and only nine grid anomalies. Munitions debris was discovered, but no MEC. However, the history of the seawall includes MEC washing up from the sea, requiring annual removal actions by active duty EOD. Also, Transect 41 in RR01 passed through what appeared to be an old building site.

5.3.5.3 DGM Characterization Results Summary

The DGM data gaps for 11 OU B-2 AOCs were filled during the 2008 field season. The surveys included 162 transects (totaling 229,741 feet), 14 30-m-grids, and 16 step-out transects (totaling 8,850 feet). The total transect length was 238,591 feet (45.18 miles). With a sensor width of 3.28 feet, this equals 17.97 acres. The total grid area was 3.21 acres.

DGM data were not collected in three of the planned transects (i.e., Transects 2, 3, and 12) in MI-03 due to terrain conditions. The following nine surveyed transects contained no target anomalies: Transects 4, 10, and 11 in MI-03; Transect 52 in RR-01; Transect 6 in RR-02; and Transects 37, 39, 41, and 42 in SA93-01. All DGM grids had target anomalies for reacquisition and intrusive investigation.

The initial anomaly intrusive investigation threshold was 3 mV on time gate 1. On August 20, 2008, this was raised to 4.3 mV on time gate 1, with a 10 percent sampling of anomalies below 4.3 mV. The increase from 3 to 4.3 mV did not change the data processing and analysis threshold, just the dig list used for intrusive investigation. This change impacted all 11 AOCs.

There were a total of 4,585 DGM anomalies; 838 of these were reported as “no finds.” This represents an 18 percent “no find” rate, which is slightly higher than normal (15 percent is normal at munitions response sites), but is consistent with the choice of using time gate 1 of the EM61-MK2 as the channel to base anomaly selections. This choice was necessary to pass the GPO with the best seed item detection rate. Only 14 no-find anomalies, which is less than 1 percent, required re-investigation; all others were identified as false positives.

Section 5.6.1 provides additional details about the DGM surveys and results of intrusive investigations at each AOC.

5.3.5.4 Anomalies Deeper than 2 feet

As indicated in Section 5.2.5.2, the maximum depth of investigation for the 2008 RI was 2 feet below the top of the mineral soil. If anomalies were present below this depth, the field teams were to record this information on field forms. Two anomalies with sources deeper than 2 feet were identified at RR-01 (RR01T18004 and RR01T21001). No other deep anomalies were identified at RR-01 or at any of the other AOCs.

5.3.5.5 Analog Operations

Analog (mag and dig) operations were employed to locate possible MEC at the apparent detonation craters within ALDA-01. Field documentation (i.e., field notes, map notations, and photographs) indicate that this survey took place and that no MEC was found. However, no formal report was prepared.

5.3.5.6 MEC Disposal and Munitions Debris Management

MEC investigation results, including quantities and types of recovered MEC for each AOC, are presented in Section 5.6.1. USAE maintained a MEC log through all operations. The log includes MEC, MPPEH, and MD encountered in each AOC. Information provided on this log included grid located, date, type of item, depth, nomenclature, etc. In addition, the log included all MEC, MD, MPPEH, and MC photograph numbers for cross-reference to the item (see Appendices C and G7 for this documentation).

MD generated by MEC operations during the 2008 RI was inspected, certified/verified as 5X, flashed, and then stored and secured in a locally leased building in the Adak magazine area pending shipment on the barge. The SUXOS prepared and signed as certifier an Inert/Demilitarization Certification/Verification Manifest, and the technically qualified U.S. Government representative signed as verifier with the following statement: “This certifies that the material potentially presenting an explosive hazard listed has been 100 percent properly inspected and re-inspected and to the best of our knowledge and belief, is inert and/or free of explosives or related material.”

No debris with energetic material other than small arms was flashed, and flashed material was classified as 5X in accordance with NAVSEA OP 5. MD was inspected by the SUXOS and the authorized QA representative prior to flashing. Any items that could not be classified as 5X were treated by detonation and then flashed. The MD was packaged in drums, sealed, and shipped first by barge, then by common carrier to Timberline Environmental, a scrap recycler/processor in Cold Springs, California. The total quantity of MD from the 2008 RI project, generated and shipped, was 694.5 pounds. During transportation on the barge from Adak to Seattle, a seal on one of the barrels was inadvertently broken. To make sure no material was introduced into the barrel, it was held at the Samson Barge and Tug warehouse until two of the NAVFAC-authorized USAE personnel could re-inspect the contents, reseal the barrel, and then ship it to the recycler.

Timberline Environmental demilitarized the debris in accordance with DoD 4160.21-M-1 and provided documentation that the material was crushed, shredded, and/or smelted prior to release for resale. USAE tracked and made sure the MPPEH chain of custody documentation was intact; Appendix C8 contains copies of this documentation.

5.3.5.7 Product QC

Product QC was conducted in accordance with the QC management plan. The locations of the QC documentation for each DFW are listed in Table 5-4.

5.3.5.8 Quality Control Audit

Two ADEC audits were performed during the 2008 field season, the first in June and the second in August. The purpose of the audits was to assess compliance with the 2008 RI Work Plan. A NOSSA audit was performed on August 1, 2008. The purpose of the NOSSA audit was to assess compliance with applicable explosives safety, environmental, and related requirements.

Overall, the auditors found the project compliant with explosives safety and environmental criteria. The audits resulted in five findings, none of which were major deficiencies, and all were subsequently corrected (see Appendix C12).

5.3.5.9 Deviations from the Project Plans

Sixteen MEC-related FCRs were submitted to the Navy and subsequently approved, as indicated in Table 5-5. No deficiency notices were issued.

TABLE 5-5
MEC Investigation FCRs

FCR[a] No.	Description of Change	Approved Date
1	ALSW-01 move transects	6/25/08
2	ALSW-01 move 30 x 30 grid out of sea	6/25/08
3	Work Plan Revisions ADEC review comments	6/25/08
4	Debris Removal SOP-01 paragraph 3-1, adjust team size	6/25/08
5	Vegetation Removal SOP-11 paragraph 6, adjust team size	6/25/08
6	Intrusive Operations SOP-05 paragraph 6.1, adjust team size	6/25/08
7	Expray Procedures for breached munitions soil sample locations	7/23/08
8	Explosive Demolition SOP-07 paragraph 4.1, revise horn requirements	6/25/08
9	Work Plan Section 6.1.4 (team member cardiopulmonary resuscitation) modified to agree with Site Health and Safety Plan	7/16/08
11[b]	MI-03 Revise Transects: due to inaccessible areas	7/31/08
12	ALSW-01 Grid Characterization: due to DGM target saturation	7/29/08
14b	ALSW-01 Seawall Transects investigations	9/10/08
15	MAG-01 Site Recon modification	9/10/08
16	DGM characterization of west end of ALSW-01	9/10/08
17	Step-out for MI-01 Grid 6	9/10/08
18	Waiver for GPO DGM Re-certification of personnel	9/30/08

[a]Copies of the FCRs are provided in Appendix C10.
[b]Missing FCRs are related to MC investigation and are listed in Table 5-6.

5.4 2008 MC Investigation Activities

The general goals for the 2008 RI MC investigation were to:

- Define the extent of MC contamination, identify areas where higher concentrations of MC are present, and determine the potential for transport/migration from source areas.
- Address USFWS concerns about sensitive ecological receptors in the study area (Andrew Lake and fish-bearing streams in OU B-2).
- Provide data to support the hazard evaluation and FS analyses for determining remedial alternatives or NOFA for the AOCs.

The areas of interest for MC sampling were selected based on known or suspected MEC densities, the potential for release of explosive chemical compounds, and the locations of sensitive ecological receptors relative to the path of migration. In general, soil, sediment, or water sampling was proposed in areas where:

- Large numbers of low-order detonations are known or suspected to have taken place.
- Areas where large-scale disposal operations may have occurred.
- Locations adjacent to or downstream from these areas (Andrew Lake and various streams) or where connectivity of surface water to the groundwater may have resulted in transport of MC.

The general sequence of MC sampling activities consisted of:

1. Marking planned sample locations in the field using designated geographic information system (GIS) coordinates and differential global position system (DGPS) equipment.
2. Field reconnaissance and verification that marked sample locations suitable for sampling (e.g., the marked location for a surface water sample was within a surface water body, or that sediment was present where a sediment sample was planned).
3. Collection of planned samples, as described in the following subsections. Trained UXO technicians escorted the sampling team during the collection of samples to verify MEC avoidance during sampling activities. Prior to collection of samples or any intrusive activity, the UXO technician used a Whites XLT to identify any potential buried MEC or debris that might pose a hazard during sampling.
4. Documentation of the sampling activity, including field notes, photographs, and other types of sampling records.
5. Storage, packaging, and shipment of the samples to the laboratory under chain-of-custody protocols.
6. Laboratory processing and analyses of the samples, followed by data validation and verification of results.

The DFW associated with MC sampling and analysis, as detailed in WS #14 of the MC QAPP included:

- Sample Collection
- Sample Documentation
- Sample Analysis
- Quality Control
- Assessment and Audits
- Data Review
- Data Management

The procedures and requirements for each of the DFW are described in the following subsections.

5.4.1 Sample Collection

Sampling activities included collection of soil, sediment, surface water, and groundwater samples. Field procedures for sampling tasks were detailed in SOPs, included as Appendix D of the MC QAPP and summarized below.

Soil Sampling. As proposed in the 2008 RI Work Plan and detailed in the MC QAPP, two soil sampling methodologies—multi-incremental sampling (MIS) and three-point composite sampling—were used to characterize soil conditions at selected AOCs during the 2008 MC investigation.

Multi-Incremental Soil Sampling. EPA Method 8330B sampling and analytical protocols were used to collect and analyze the MIS soil samples obtained at nine OU B-2 AOCs. MIS sampling activities, including grid deployment and collection of subsamples, were recorded using photographs, field notes, and field sampling records.

MIS soil sampling was conducted by first identifying and marking the location of interest (typically, an area where breached munitions or similar source materials were found during previous investigations or during the 2008 investigation) using DGPS equipment. Once the sample location was identified, a MIS sample grid was constructed around and centered on the marked sample location. A 10-foot by 10-foot MIS sample grid was constructed around single breached item locations, and a 50-foot by 50-foot MIS sample grid was constructed around areas where clusters of breached items had been found. The MIS sample grid was oriented with the top of the grid facing north when possible; however, other orientations were used in some locations due to site features and topography. The MIS sample grid was then subdivided into 30 approximately equal-sized subsample grid units in a 5- by 6-unit grid configuration. A random number generator was then used to determine which quadrant (i.e., NW, NE, SE, SW) of each grid cell was to be subsampled to make up the MIS soil sample.

Each subsample location was then screened with a Whites XLT prior to removal of vegetation and exposure of soil. If the designated subsample locations were all clear of anomalies, the surface vegetation at the locations was removed using a decontaminated spade to expose the underlying mineral soil. A clean stainless steel spoon was then used to collect the subsamples from the upper 3 inches (0.4 foot) of mineral soil. Disposable nitrile gloves were worn during handling of sampling equipment and collection of soil samples. Sufficient soil was collected from each of the 30 subsample locations to create at least one kilogram (2.2 pounds) of soil for processing and laboratory analysis.

If anomalies were detected by the Whites XLT, subsample locations were moved to alternate locations within the quadrant or to a different quadrant within the cell so that the buried hazard was avoided. Such changes in subsample locations were recorded in the field notes associated with the sample location.

Once collected, the soil sample was placed in a doubled-bagged, 1-gallon sealed Ziploc-type bag, recorded and labeled, and stored at 4ºC within a custody-controlled sample refrigerator until offsite shipment. The collected soil samples were shipped overnight in a chilled cooler via Alaska Airlines Goldstreak to the designated analytical laboratory (i.e., APPL, Inc.) for processing and analysis of MC and perchlorate by EPA Method 8330B and Method 6850. Pursuant to the MC QAPP, perchlorate analysis was only conducted at AOCs where munitions with propellants may have been disposed of or fired.

The described MIS approach adheres to EPA Method 8330B sampling protocols. In addition to parent MIS soil samples, triplicate soil samples were collected using identical sample methods within the same sample grid. The exception was that each MIS triplicate soil sample was collected from two alternate quadrants within each subsample grid determined using a random number generator. As a result, at designated triplicate sampling locations, MIS samples were collected from three of the four quadrants within each grid cell: one as the MIS parent, one as the MIS duplicate, and one as the MIS triplicate. The parent, duplicate, and triplicate MIS soil samples were given separate sample identification numbers.

In addition to the samples collected for MC and perchlorate analysis, a separate soil sample was to be collected at OB/OD-01 to characterize geotechnical conditions in the area for later use in determining appropriate remedial technologies for the area during the FS. This sample was submitted to Analytical Resources, Inc., in Seattle, Washington, for ASTM 421/422 (sieve and hydrometer) analyses.

Information about the individual MIS soil samples collected during this investigation is provided in Section 5.4.

Three-point Composite Soil Sampling. As proposed in the 2008 RI Work Plan and detailed in the MC QAPP, a three-point composite soil sample was collected only at ALDA-01. Use of this sampling method was proposed because the surface material in the craters at ALDA-01 is composed primarily of cobbles and boulders, with little soil, making collection of a 30-point MIS soil sample very difficult.

Three-point composite soil sampling was performed by first identifying and marking the crater designated for sampling in ALDA-01. The crater surface was then evaluated to identify three subsample locations where soil was present and where no subsurface anomalies were present (as determined by the Whites XLT). Surface vegetation at the three locations was removed using a decontaminated spade to expose the underlying mineral soil. A clean stainless steel spoon was then used to collect the subsamples from the upper 3 inches (0.4 foot) of mineral soil. Disposable nitrile gloves were worn during handling of sampling equipment and collection of soil samples. Sufficient soil was collected from each of the subsample locations to create at least 1 kilogram (2.2 pounds) of soil for processing and laboratory analysis. Three-point composite soil sampling activities were recorded using photographs, field notes, and field sampling records.

Once collected, the soil sample was placed in a doubled-bagged, 1-gallon sealed Ziploc-type bag, recorded and labeled, and stored at 4ºC within a custody-controlled sample refrigerator until offsite shipment. All collected soil samples were shipped overnight in a chilled cooler via Alaska Airlines Goldstreak to the designated analytical laboratory (i.e., APPL, Inc.) for processing and analysis of MC by EPA Method 8330B.

Sediment Sampling. Sediment samples were obtained from streams and creeks draining four OU B-2 AOCs. The samples were collected according to the five-point composite methodology proposed in the MC QAPP. Samples were composited in the field. Sediment sampling activities were recorded using photographs, field notes, and field sampling records.

Five-point composite sampling was performed by first identifying and marking the location of the proposed sample using DGPS equipment. The stream and sediment features close to the marked sample area were then evaluated for acceptable and representative sediment sample collection with attention to submerged depositional areas, zones of flowing water, and personnel safety. All sediment sample locations were approached from downstream or cross-stream whenever possible. If the sampling program for a location also included collection of a surface water sample, the water sample was collected before the sediment ample.

Once an acceptable sample area within the stream bed was identified, five subsample locations were identified for each sediment sample. As site conditions allowed, the subsample locations were oriented in a box pattern with subsamples being collected from each corner and at the center of the box. However, such a configuration was not suitable for several locations because of stream and sample area characteristics (i.e., sediment was only present in narrow bars along curves and behind larger rocks). The five locations were then screened for MEC hazards using a Whites XLT. If a hazard was identified, the subsample location was moved to another suitable location.

The five-point sediment sample was created by using a clean stainless steel spoon to collect sediment from the upper 3 inches (0.4 foot) of accumulated material at the sub-location. Disposable nitrile gloves were worn during handling of sampling equipment and collection of sediment samples. Approximately equal volumes of sediment were obtained at each subsample location to make up a minimum weight of 1 kilogram (2.2 pounds) for each sediment sample. Coarser-grained materials, such as gravel and cobbles, were not included in the subsamples. In addition, visible organic matter was removed and residual water was decanted from the composited sample.

Once collected, the sediment sample was placed in a doubled-bagged, 1-gallon sealed Ziploc-type bag, recorded and labeled, and stored at 4ºC within a custody-controlled sample refrigerator until offsite shipment. All collected sediment samples were shipped overnight in a chilled cooler via Alaska Airlines Goldstreak to the designated analytical laboratory (i.e., APPL, Inc.) for processing and analysis of MC and perchlorate by EPA Method 8330B and Method 6850.

Field duplicate samples were obtained at selected sediment sample locations. At these locations, twice as much sediment was obtained at each subsample location; the sediment was then composited and split into two separate samples with different sample identification numbers.

Surface Water Sampling. Surface water samples were obtained from streams and creeks draining three OU B-2 AOCs. The samples were collected according to the grab sample methodology proposed in the MC QAPP. Surface water sampling activities were recorded using photographs, field notes, and field sampling records.

Surface water sampling was performed by first identifying and marking the location of the proposed sample using DGPS equipment. The stream features at the marked sample area were then evaluated for representative sample collection with attention to zones of evenly flowing water, adequate sampling water depth, personnel safety, and co-location with sediment samples, if applicable. All surface water sample locations were approached from downstream or cross-stream, whenever possible, and care was taken not to introduce significant amounts of sediment into the sample. When necessary, sediment was allowed to settle so surface water resembled the initial, undisturbed water clarity prior to collecting any surface water samples. If the sampling program for a location also included collection of a sediment sample, the water sample was collected before the sediment sample.

Surface water samples were collected directly into the sample containers. Disposable nitrile gloves were worn to collect the surface water sample. The sample bottle for MC analysis was collected first, followed by the sample bottle for perchlorate analysis, if required. Sample bottles were filled by lowering the mouth of the (unpreserved) sample bottle into the water until the sample container just began to fill with surface water. The MC sample bottles were filled up to the neck of the bottle. The perchlorate sample bottles were filled approximately two-thirds of the way full (approximately 80 mL of water), leaving headspace in order to minimize the possibility of anaerobic conditions developing during sample storage.[1] Field duplicate samples were obtained by collecting a second set of sample bottles at the designated field duplicate location and marking the bottles with a different sample identification number.

Once collected, the sample bottles were labeled and stored at 4ºC within a custody-controlled sample refrigerator until offsite shipment. All collected surface water samples were shipped overnight in a cushioned, chilled cooler via Alaska Airlines Goldstreak to the designated analytical laboratory (i.e., APPL, Inc.) for analysis of MC and perchlorate by EPA Method 8330B and Method 6850.

Groundwater Sampling. Two methods were used to obtain groundwater samples during the 2008 MC investigation: sampling from temporary monitoring wells, and direct sampling at groundwater seeps, as described below.

Temporary Monitoring Well Installation and Sampling. Six temporary monitoring wells were installed along the eastern margin of RR-04 to allow sampling and characterization of groundwater discharging from the Range Complex to Andrew Lake. Well installation procedures included the following:

1. Proposed well locations were marked using DGPS.

2. Reconnaissance and evaluation of each proposed well location to gauge the feasibility of well installation, with particular attention paid to accessibility, topography, and personnel safety. Once acceptable well locations were identified, the ground surface was screened for MEC hazards using a Whites XLT. If MEC or other unsuitable field conditions were found then another more suitable location was selected.

3. Access to groundwater at each location was accomplished by excavating a 1-foot-diameter pit to approximately 3 to 4 feet bgs using clean, decontaminated spades, followed by use of a 4-inch-diameter, decontaminated, stainless steel hand auger to advance the borehole 1 to 2 feet into the saturated zone.[2] Soil

[1] Surface water samples submitted for perchlorate analysis were filtered using 0.45- and 0.2-µm polytetrafluoroethylene membrane filters upon arrival at the laboratory.

[2] Equipment blanks were taken from the decontaminated hand auger and from the materials used to construct the temporary wells.

conditions encountered in each borehole, as determined by visual examination of cuttings, were recorded on soil boring logs.

4. A temporary monitoring well, constructed of 0.75-inch-diameter PVC, with a 1-foot-long PVC drive point screen, was installed in each open borehole. The total depth of the well and associated well construction information were recorded in field notes and on the soil boring log.

5. Depth to water measurements were obtained and groundwater samples were collected from the wells at a minimum of 24 hours after well installation to allow water levels to stabilize and for sediment in the water column to settle.

6. Groundwater sampling was conducted using a Geotech peristaltic pump and disposable small-diameter polyethylene tubing. The tubing was slowly inserted into the temporary well point until the open end was centered within the groundwater column inside the well. The sample tubing was then attached to the peristaltic pump and a Horiba U-22 flow-through cell, and the well was purged until chemical/physical characteristics (i.e., temperature, pH, specific conductance, dissolved oxygen, redox potential, and turbidity) stabilized to within <10 percent change and 10 nephelometric turbidity units (NTU) for turbidity. Care was taken to adjust the flow rate to not significantly draw down the water level within the well during purging and sampling. Disposable nitrile gloves were worn during handling of sampling equipment and collection of groundwater samples.

7. Groundwater sample containers were filled directly from the pump discharge. The sample bottles for MC analysis were collected first and each bottle was filled up to the neck of the bottle. The sample bottles for perchlorate analysis were filled after installing a 0.45-µm disposable polytetrafluoroethylene (PTFE) membrane in-line filter on the pump discharge line.[3] Each perchlorate sample bottle was filled approximately two-thirds of the way full (approximately 80 mL of water), leaving headspace in order to minimize the possibility of anaerobic conditions developing during sample storage. Field duplicate samples were obtained by collecting a second set of sample bottles at the designated field duplicate location and marking the bottles with a different sample identification number.

8. Once collected, the groundwater sample bottles were labeled and stored at 4°C within a custody-controlled sample refrigerator until offsite shipment. All collected groundwater samples were shipped overnight in a cushioned, chilled cooler via Alaska Airlines Goldstreak to the designated analytical laboratory (i.e., APPL, Inc.) for analysis of MC and perchlorate by EPA Method 8330B and Method 6850.

The temporary monitoring wells were removed and the boreholes were backfilled with soil following receipt of analytical results from the laboratory.

Groundwater Seep Sampling. Two conditional groundwater samples were collected from naturally occurring groundwater seeps along the valley walls within MI-02. These sample locations were identified by examining the ground surface near the base of hillsides and valley walls within MI-02 for evidence of groundwater seeps. Two suitable locations, where flowing water was visibly seeping from the toe of a slope, were identified for sampling. The groundwater seep sampling procedure consisted of the following:

1. The DGPS coordinates were recorded at each seep sample location.

2. Screening was conducted for MEC hazards using a Whites XLT.

3. The natural pool at the seep was expanded to a depth of approximately 12 inches using a decontaminated spade. Once the sample collection point was excavated, the suspended sediment was allowed to settle until water flowing through the area resembled the initial, undisturbed water clarity.

[3] Groundwater samples submitted for perchlorate analysis were also filtered using a 0.2-µm PTFE membrane filter upon arrival at the laboratory.

4. Seep samples were collected directly into the sample containers. Disposable nitrile gloves were worn to collect the samples. The sample bottle for MC analysis was filled first, followed by the sample bottle for perchlorate analysis. Sample bottles were filled by lowering the mouth of the (unpreserved) sample bottle into the water until the sample container just began to fill with surface water. The MC sample bottles were filled up to the neck of the bottle. The perchlorate sample bottles were filled approximately two-thirds of the way full (approximately 80 mL of water), leaving headspace in order to minimize the possibility of anaerobic conditions developing during sample storage.[4]

5. Once collected, the sample bottles were labeled and stored at 4ºC within a custody-controlled sample refrigerator until offsite shipment. All collected seep water samples were shipped overnight in a cushioned, chilled cooler via Alaska Airlines Goldstreak to the designated analytical laboratory (i.e., APPL, Inc.) for analysis of MC and perchlorate by EPA Method 8330B and Method 6850, respectively.

5.4.2 Field Documentation

All 2008 MC investigation activities were documented by MC investigation personnel in the field. The following sections describe the elements of the field documentation process.

5.4.2.1 Field Logbook

The field logbook was a bound notebook that contained consecutively numbered pages that could not be removed. Daily entries into the logbook contained a variety of field information including samples collected, sample locations, field sketches, general field observations, weather conditions, daily events, etc. At the beginning of each day, the date, start time, daily task(s), weather conditions, field personnel present, and any other relevant start-up information were documented in the field logbook. During the day, a summary of site activities was recorded in the logbook. Information recorded in other field notes (i.e., groundwater sampling sheets, calibration sheets, Site Health and Safety Officer's notebook, etc.) was not duplicated in the field notebook unless determined necessary or valuable. All entries were made in waterproof black pen. No erasures were permitted. If an incorrect entry was made, the entry was crossed out with a single strike mark and initialed. The logbook was reviewed and signed by the Field Sampling Lead or designated responsible team member at the end of each day.

5.4.2.2 Photographs

Photographs were taken throughout the 2008 MC investigation to document sample areas, individual sample locations, sampling activities, collected samples, and other investigation observations. A record of photographs taken at a site was documented in the field logbook and/or photograph database file. When photographs were taken of a site or any sampling location or item, they were uniquely numbered to correspond to the field logbook and/or database file entries. The unique digital photograph number, sample location ID, date, AOC, photograph direction, description, name of the photographer, and weather conditions were entered in the field logbook and/or photograph database file as the photographs were taken. No special lenses, films, filters, and other image-enhancement techniques were used for photographic documentation.

5.4.2.3 Calibration Logs

Calibration records for all MC sampling equipment requiring calibration were documented in either calibration log sheets or in the field logbook. Each piece of equipment was calibrated prior to arrival onsite and prior to use for sample collection. All calibration measurements were recorded and acceptable calibration was verified, signed, and dated by the designated Equipment Manager or Field Sampling Lead.

5.4.2.4 Sample Collection Logs

Sample collection activities were documented on sample collection logs. Information such as AOC, field team, log preparer, log completion date, sample type, sample location ID, sample ID, sample medium, collection date and time, QA/QC sample ID (if applicable), target analytes/analysis, chain-of-custody number, shipment cooler

[4] Seep samples submitted for perchlorate analysis were filtered using 0.2-µm PTFE membrane filters upon arrival at the laboratory.

number, total number of samples, and sampling observations were recorded on each sample collection log. Each sample collection log was completed by the Field Sampling Lead or designated responsible team member at the end of each day.

5.4.2.5 Well Purge and Sampling Sheets

Groundwater sampling activities, including purge records and sample collection information, were documented on well purge and sampling sheets. Information such as AOC, project name and number, field team, recorded date, sample ID, well purge start and stop times, sample collection date and time, QA/QC sample ID if applicable, weather conditions, depth to groundwater, total well depth, pump flow rate, total purge volume, filtering methods, geochemical parameter values, parameter stabilization, sensory observations, general comments, and other observations were recorded. Each well purge and sampling sheet was completed in the field during well purging and sampling by MC investigation personnel. These sheets were reviewed and approved by the Field Sampling Lead or designated responsible team member at the end of each day.

5.4.2.6 Sample Shipping Records

Shipments of all samples were documented on sample shipping sheets and with Alaska Airlines Goldstreak air waybills. Information such as AOC number, log preparer, log completion date, laboratory contact person, chain-of-custody number, shipment cooler number, sample shipment date, and shipping comments were recorded on each sample shipping sheet. Sample shipment details such as shipper and consignee information, nature and quantity of goods, handling information, delivery type, flight information, number of pieces, gross weight, and shipment cost were documented on the Alaska Airlines Goldstreak air waybills. Each sample shipping sheet was completed by the Field Sampling Lead or designated responsible team member and all air waybills were completed by Alaska Airlines Goldstreak personnel prior to sample shipment.

5.4.2.7 Chain-of-Custody Records

Chain-of-custody records (COCs) were completed for each sample cooler prior to submittal to the project laboratory. Each COC contained information including COC number, project and invoice contact information, project number, sampler’s name and signature, shipment date, shipment carrier, waybill number, sample IDs, sample location, sample collection dates and times, sample matrix type, number of sample containers, analysis and method number requested, data report turnaround time, sample disposal methods, and date, time, and signature when the COC was relinquished prior to shipment. Hard copies of each COC were included in each respective sample cooler and submitted to the laboratory for accurate sample data entry and recordkeeping. Hard copies and scanned digital copies of each COC were also retained in the project files. Once the sample shipment(s) arrived at the designated project laboratory, the included COC(s) were reviewed and further completed (i.e., received date, time, signature, and cooler temperature) as the sample shipment was accepted. Full, completed copies of the COCs were then returned from the laboratory with the sample data and added to the project files.

5.4.2.8 Deviations from the Project Plan

Field changes to plans or procedures were documented using FCR forms and organized in a FCR log. These forms documented Navy concurrence with any in-field changes. Each FCR was used to request and document changes identified as a result of unanticipated field conditions or identification of field activities that were procedural and would not affect the original task order cost, schedule, design specification, or scope of work. All FCR forms were signed by the NTR to acknowledge the changed condition. The Navy remediation project manager (RPM), EPA, and ADEC were provided copies of these documents for review and concurrence, as appropriate.

5.4.3 Sample Processing and Laboratory Analyses

Surface soil, sediment, shallow groundwater, and surface water samples and associated QC samples were collected. These samples were sent to an analytical laboratory for processing and analysis of MC and perchlorate (as applicable for each sample location) in accordance with method requirements and as specified in the DoD Quality Systems Manual (QSM) for Environmental Laboratories Final Version 3.0 and the MC QAPP. The MC and perchlorate processing and analyses were conducted by APPL, Inc., in Fresno, California. APPL, Inc. was identified by USAE and approved by the Naval Facilities Engineering Service Center (NFESC) to perform the sample processing and analyses associated with these methods.

The geotechnical soil sample was submitted to Analytical Resources, Inc., in Seattle, Washington, for grain size analysis.

5.4.3.1 Soil and Sediment Processing

Soil and sediment samples submitted to the laboratory for MC and perchlorate analyses required special processing, as detailed in EPA Method 8330B. The processing by the laboratory applied to all soil and sediment samples, regardless of whether they were collected using multi-increment or composite sampling. The processing also applied to the sample aliquots being analyzed for perchlorate using Method 6850.

Each soil and sediment sample was removed from its container, air-dried, and sieved through a #10 sieve to remove particles greater than 2 mm (these were discarded and not included in the rest of the procedure). The sieved sample was then pulverized by grinding in a ring puck mill and placed on a stainless steel tray for subsampling. Thirty different increments (approximately 0.3 gram each) were obtained from randomly chosen locations on the tray to obtain a 10-gram aliquot (approximately) for Method 8330B sample extraction and analysis. After subsampling for Method 8330B, the laboratory then subsampled for Method 6850 analysis by randomly choosing 30 different increments (approximately 0.035 grams each) to obtain a 1-gram (minimum) aliquot for analysis.

5.4.3.2 Water Sample Processing

Although field filtration to remove potentially perchlorate-degrading microbes is recommended in Method 6850, field conditions did not allow for reliable operation of pumps and devices capable of filtration using the specified 0.2-μm PTFE membrane filters. Water samples for Method 8330B analysis were prepared by the laboratory using solid-phase extraction prior to analysis. No filtration was required.

5.4.4 Quality Control

The following types of QA/QC samples were collected during the course of the 2008 field season:

- **Equipment Blanks:** The purpose of equipment blank samples is to evaluate the possibility of cross-contamination of samples caused by use of inadequately decontaminated sampling equipment or construction materials. Equipment blanks were collected when reusable equipment was re-used during sampling activities (e.g., during advancement of borings for monitoring well installation using a hand auger) or when sampling equipment or supplies were not certified as clean upon arrival at the site (e.g., PVC pipe used for well casing). One equipment blank was collected for each type of use or re-use. The equipment blanks were collected following decontamination of the field equipment or sampling supplies, and the blanks were analyzed for the same parameters as the associated samples (e.g., groundwater samples obtained at the wells). Commercially available distilled water was poured over or through the equipment, and the rinsate was then collected into the appropriate sample containers for each analytical method.
- **Matrix Spike/Matrix Spike Duplicate (MS/MSD).** The purpose of MS/MSD samples is to evaluate the quality of laboratory analytical methods. Extra volumes of sample are typically required for MS/MSD protocols, as was the case for groundwater and surface water. However, because of the volumes of soil and sediment that were required for the Method 8830B analysis, no extra volume was required to make up the MS/MSD samples for these media. MS/MSDs were evaluated at a rate of 1 set per 20 samples.
- **Field Duplicates.** The purpose of field duplicates is to gauge the variability in laboratory-reported sample results from a single sample location and interval. Field duplicates were collected at a frequency of 1 set per 10 samples per matrix (excluding MIS soil samples, which are described below). Extra sample volume was collected at each designated field duplicate location. The volume was then divided equally between sample containers, with one set of containers marked with the actual sample identification number and the second, field duplicate sample set marked with a different sample identification number.

- **MIS Triplicates.** The purpose of MIS triplicate samples is to gauge the representativeness of the results for MIS samples collected in a decision area (e.g., 10-foot by 10-foot area around a breached munition). MIS triplicates were collected at a frequency of one set for each historical use/activity type in OU B-2 (e.g., wash-up area, target/impact area, open-burn disposal area, dump disposal area, small arms range, storage area).

5.4.5 Assessments and Audits

Assessments and audits for the MC portion of the RI included a pre-investigation “readiness review” prior to commencement of field program and prior to initiating major phases of work, field operations audits performed by NOSSA, and work plan compliance audits performed by ADEC. The Project QC Manager was responsible for verifying compliance with the work plan and documenting observations on the Contractor QC Report.

In addition to field audits, the Navy also conducted systems/performance audits of the offsite analytical laboratory (i.e., APPL, Inc.).

5.4.6 Analytical Data Review

Analytical data review was to include tabulation and compilation of analytical results and associated QA/QC information for each sample in sample delivery group (SDG) packages in both hard copy and electronic formats. The analytical data were then to be validated by an independent data validation firm using Level IV data validation procedures and guidance specified in the MC QAPP.

5.4.7 Data Management

Following validation, the field documentation, analytical data and associated validation codes were to be uploaded into the project database for evaluation, and the hard copy and electronic versions of the laboratory reports were to be submitted to the appropriate data management contractors.

5.5 2008 MC Investigation Results and Recommendations

The 2008 field work was conducted in accordance with the DFWs detailed in the MC QAPP or with modifications approved through the FCR process. Table 5-6 lists the DFWs for MC and provides a review of results and recommendations. In addition, this section provides a summary of the results for the principal 2008 MC data gathering and QC activities.

5.5.1 Sample Collection

Soil, sediment, surface water, and groundwater samples were collected as planned, no deviations other than minor adjustments to three groundwater samples at RR-04 were required (FCR 10). FCRs associated with the MC investigation are listed in Table 5-7.

Table 5-8 lists the AOCs, media, sample types, sample identification numbers, and target analytes for the samples.

5.5.2 Field Documentation

Field documentation for collection and shipment of the samples, including field notes, photographs, sample collection records, field equipment calibration logs, and sample chains of custody, was completed in accordance with the DFWs. The documents were reviewed by the field team leader and project chemist, and corrections were made as required.

5.5.3 Laboratory Processing and Analysis

The samples were received, processed, and analyzed at the laboratory as planned, with two exceptions:

- A cooler containing surface water and sediment samples collected in late June and shipped via Gold Streak arrived at the laboratory with an internal temperature well above the 4 ˚C criterion for acceptance due to storage of the cooler outside of the Gold Streak facility in Fremont, California (delivery of the samples was delayed because of the Fourth of July holiday). The over-temperature samples were discarded and replacement samples were collected and shipped to the laboratory without incident.

TABLE 5-6
2008 MC Investigation Findings and Recommendations by DFW

DFW	Task	Documentation Location	Issues/ Deviations	Results	Recommendations
Sample Collection	Soil	Sections 5.4 and 5.6.2		All planned soil samples collected.	None
	Sediment	Sections 5.4 and 5.6.2	Re-sampling required at several locations due to shipping problem (samples arrived at lab at unacceptable temperature)	All planned sediment samples collected (or re-collected, as necessary).	None
	Surface Water	Sections 5.4 and 5.6.2	Re-sampling required at several locations due to shipping problem (samples arrived at lab at unacceptable temperature)	All planned surface water samples collected (or re-collected, as necessary).	None
	Groundwater	Sections 5.4 and 5.6.2	Temporary well locations in RR-04 were moved to accommodate site conditions that did not allow for safe well installation and sampling (FCR-10)	All planned groundwater samples collected, two contingency seep samples also collected.	None
Field Documentation	Field logbook	Appendix D1	None	Field logbook completed as required.	None
	Photographs	Appendix D2	None	Photographs completed as required.	None
	Calibration Logs	Appendix D3	None	Calibration logs completed as required.	None
	Sample Collection Logs	Appendix D4	None	Sample collection logs completed as required.	None
	Well Purge and Sampling Sheets	Appendix D4	None	Well purge and sampling sheets completed as required.	None
	Sample Shipping Records	Appendix D5	None	Shipping records completed as required.	None
	Chain of custody Records	Appendix D5	None	COCs completed as required.	None
	Field Change Requests	Appendix D6	None	FCRs completed as required.	None

TABLE 5-6
2008 MC Investigation Findings and Recommendations by DFW

DFW	Task	Documentation Location	Issues/ Deviations	Results	Recommendations
Laboratory Processing and Analysis	Lab Processing	Appendix E1	8330B processing (air drying, grinding, sieving) not feasible for one MIS sample because too wet (FCR-13)	Processing performed in accordance with method requirements.	None
	8830B Analysis	Appendix E1	None	All analyses were performed in accordance with method requirements and as specified in the DoD QSM for Environmental Laboratories Final Version 3.0 and in the MC QAPP.	None
	6850 Analysis	Appendix E1	None	All analyses were performed in accordance with method requirements and as specified in the DoD QSM for Environmental Laboratories Final Version 3.0 and in the MC QAPP.	None
	Geotechnical	Appendix E1	None	Analysis was performed in accordance with method requirements.	None
Quality Assurance / Quality Control	MIS soil triplicates	Appendices D4 and E1	None	Triplicates collected as proposed. No target analytes detected in any triplicate samples so no evaluations of representativeness conducted.	None,
	Field duplicates	Appendices D4 and E1	None	Duplicates collected as proposed. No target analytes detected in any duplicate samples so no evaluations of representativeness conducted.	None
	Rinsate blanks	Appendices D4 and E1	None	Rinsate samples collected as proposed. No target analytes detected in any sample.	None
	MS/MSD	Appendices D4 and E1	None	MS/MSDs collected and analyzed by laboratory as proposed. Results were accepted by laboratory reviewers and validator.	None

TABLE 5-6
2008 MC Investigation Findings and Recommendations by DFW

DFW	Task	Documentation Location	Issues/ Deviations	Results	Recommendations
Assessments and Audits	Readiness Review	Appendix D7	None	Completed as required. No deficiencies identified.	None
	Compliance with Work Plan	Appendix CC1	None	Completed as required. No deficiencies identified.	None
	Field Audit	Appendix C11	None	Two ADEC audits completed (June and August 2008)—no MC investigation-related deficiencies were identified. One NOSSA audit completed (August 2008). Overall the project was found to be compliant with explosives safety and environmental criteria. No MC investigation-related deficiencies were identified.	None
Data Review	Laboratory Review	Appendix D1	None	Completed as required.	None
	Level IV Data Validation	Appendix D2	None	Completed as required. Analytical data found to be usable.	None
Data Management	Field documentation, analytical data and associated validation codes uploaded into the project database	Project database used to generate tables and figures included in report	None	Completed as required.	None
	Electronic submittal to URS	Data submitted following finalization of RI Report			None
	Hard copy submittal to Tetra Tech	Data submitted following finalization of RI Report			None

- An MIS sample submitted to the laboratory for Method 8330B analysis contained too much moisture to allow for air-drying within the designated hold time for the analysis. Therefore, the sample could not be processed (i.e., grinding and sieving) in accordance with the MIS protocols, and standard 8330B protocols were used instead (FCR 13).

Sample receipt information and case narratives documenting sample preparation and analysis for each SDG are provided in the laboratory reports included in Appendix I. The analytical results for the samples and associated laboratory QA/QC data were evaluated by the laboratory and the project chemist according to the Method 8330B and 6850 protocols. All issues identified during these reviews were resolved, as documented in the case narratives for each SDG included in Appendix E1.

TABLE 5-7
Approved MC Investigation FCRs

FCR No.	Description of Change	Approved Date
10	Move three temporary monitoring wells in RR-04 to more accessible or safe locations	7/17/08
13	Modify sample preparation for one MIS soil sample due to high moisture content	8/24/08

5.5.4 QA/QC

QA/QC samples were collected and analyzed at the rates specified by the MC QAPP. The locations and types of QA/QC samples collected at OU B-2 during the RI are included in Table 5-8. Note that because collection of the MIS soil and 5-point composite sediment samples involved submittal of large volumes of material for processing and analysis, extra volumes of these media were not required by the laboratory for MS/MSD analysis.

Triplicate MIS soil samples were collected as proposed. However, no target analytes were detected in any triplicate samples, so no evaluations of MIS representativeness were conducted.

5.5.5 Assessments and Audits

A pre-investigation “readiness review” was performed by the Field Sampling Lead prior to commencement of field program and prior to initiating major phases of work. The Project QC Manager was responsible for verifying compliance with the work plan and documenting observations on the Contractor QC Report.

Two ADEC audits were performed during the 2008 field season, the first in June and the second in August. The purpose of the audits was to assess compliance with the 2008 RI Work Plan. A NOSSA audit was performed on August 1, 2008. The purpose of the NOSSA audit was to assess compliance with applicable explosives safety, environmental, and related requirements. No issues or recommendations related to the MC investigation were identified during the audits (see Appendix C12).

5.5.6 Data Review

The analytical laboratory tabulated and compiled the analytical results and associated QA/QC information for each sample in SDG packages. The data were reported in a CLP equivalent data package format (i.e., hard copy) and NEDD format.

The analytical data were validated by an independent data validation firm using Level IV data validation procedures and guidance specified in NAVFAC NW’s *Standard Operating Procedure (SOP) for Navy Environmental Information Transfer, Version 4.0* (per Data Validation Procedures in the Field Standard Operating Procedures section), *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (EPA, 1999), and *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 2004a).

TABLE 5-8
2008 RI Sampling Information

AOC	Sample ID	Medium	Depth	Sample Type	Sample Date	QA/QC	Target Analytes
ALDA-01	ALDA-01-SL-01	Soil	0 – 3 inches	3-point composite	7/5/2008		MC
	ALDA-01-SL-101	Soil	0 – 3 inches	3-point composite	7/5/2008	Field duplicate	MC
	ALDA-02-SD-01	Sediment	0 – 3 inches	5-point Composite	7/5/2008		MC
C1-01	C1-01-SL-01	Soil	0 – 3 inches	MIS (50- x 50-foot grid)	7/12/2008		MC
MI-01	MI-01-SL-01	Soil	0 – 3 inches	MIS (10- x 10-foot grid)	7/16/2008		MC and perchlorate
	MI-01-SL-101	Soil	0 – 3 inches	MIS (10- x 10-foot grid)	7/16/2008	MIS duplicate	MC and perchlorate
	MI-01-SL-201	Soil	0 – 3 inches	MIS (10- x 10-foot grid)	7/16/2008	MIS triplicate	MC and perchlorate
MI-02	MI-02-SL-01	Soil	0 – 3 inches	MIS (50- x 50-foot grid)	7/17/2008	MS/MSD	MC and perchlorate
	MI-02-GW-01	Groundwater	NA	Grab	7/18/2008		MC and perchlorate
	MI-02-GW-02	Groundwater	NA	Grab	7/17/2008		MC and perchlorate
MI-03	MI-03-SL-01	Soil	0 – 3 inches	MIS (50-x 50-foot grid)	7/10/2008		MC and perchlorate
	MI-03-SL-02	Soil	0 – 3 inches	MIS (10- x 10-foot grid)	7/18/2008		MC and perchlorate
OB/OD-01	OBOD-01-SL-01	Soil	0 – 3 inches	MIS (10- x 10-foot grid)	7/19/2008		MC, perchlorate, grain size
	OBOD-01-SL-02	Soil	0 – 3 inches	MIS (10- x 10-foot grid)	7/22/2008		MC and perchlorate
	OBOD-01-SL-03	Soil	0 – 3 inches	MIS (10- x 10-foot grid)	7/10/2008		MC and perchlorate
	OBOD-01-SL-103	Soil	0 – 3 inches	MIS (10- x 10-foot grid)	7/10/2008	MIS Duplicate	MC and perchlorate
	OBOD-01-SL-203	Soil	0 – 3 inches	MIS (10- x 10-foot grid)	7/10/2008	MIS Triplicate	MC and perchlorate
RR-01	RR-01-SL-01	Sediment	0 – 3 inches	5-point composite	7/9/2008		MC and perchlorate
RR-02	RR-02-SL-01	Soil	0 – 3 inches	MIS (50- x 50-foot grid)	7/18/2008		MC and perchlorate

TABLE 5-8
2008 RI Sampling Information

AOC	Sample ID	Medium	Depth	Sample Type	Sample Date	QA/QC	Target Analytes
RR-04	RR-04-SD-01	Sediment	0 – 3 inches	5-point Composite	7/9/2008		MC and perchlorate
	RR-04-SD-101	Sediment	0 – 3 inches	5-point Composite	7/9/2008	Field Duplicate	MC and perchlorate
	RR-04-SD-02	Sediment	0 – 3 inches	5-point Composite	7/9/2008		MC and perchlorate
	RR-04-SW-01	Surface Water	NA	Grab	7/9/2008		MC and perchlorate
	RR-04-SW-101	Surface Water	NA	Grab	7/9/2008	Field Duplicate	MC and perchlorate
	RR-04-GW-01	Groundwater	NA	Grab	7/14/2008		MC and perchlorate
	RR-04-GW-02	Groundwater	NA	Grab	7/14/2008		MC and perchlorate
	RR-04-GW-03	Groundwater	NA	Grab	7/15/2008		MC and perchlorate
	RR-04-GW-103	Groundwater	NA	Grab	7/15/2008	Field Duplicate	MC and perchlorate
	RR-04-GW-04	Groundwater	NA	Grab	7/15/2008		MC and perchlorate
	RR-04-GW-05	Groundwater	NA	Grab	7/15/2008		MC and perchlorate
	RR-04-GW-06	Groundwater	NA	Grab	7/16/2008	MS/MSD	MC and perchlorate
SA93-01	SA93-01-SL-01	Soil	0 – 3 inches	MIS (50- x 50-foot grid)	7/4/2008		MC and perchlorate
	SA93-01-SL-02	Soil	0 – 3 inches	MIS (50- x 50-foot grid)	7/4/2008		MC and perchlorate
	SA93-01-SD-01	Sediment	0 – 3 inches	5-point Composite	6/28/2008	MS/MSD	MC and perchlorate
	SA93-01-SW-01	Surface Water	NA	Grab	6/28/2008	MS/MSD	MC and perchlorate
SA93-02	SA93-02-SD-01	Sediment	0 – 3 inches	5-point Composite	6/28/2008		MC and perchlorate
	SA93-02-SW-01	Surface Water	NA	Grab	6/28/2008		MC and perchlorate

These validation documents do not specifically address MC or perchlorate analysis and are more pertinent to analyses performed using Contract Laboratory Program analytical methodology; however, since no procedures specific to MC are available, they were used as guidance for the validation process. The validation evaluated the following:

- Sample receipt conditions
- Holding times
- Calibration results
- Method blank results
- Surrogate recovery results (MC only)
- Internal standard results (perchlorate only)
- Laboratory control sample results
- MS/MSD results
- Analyte identification
- Verification of calculations

The validations were performed using project-specific criteria, as well as criteria required in the DoD QSM, DoD Perchlorate Handbook, and analytical methods. No issues were identified by the independent validation firm and all data were found to be usable for evaluation of possible MC contamination. The validation reports are included in Appendix E2.

5.5.7 Data Management

Following validation, the field documentation, analytical data and associated validation codes were uploaded into the project database for evaluation and incorporation into this report. The analytical data for the soil, sediment, groundwater, and surface water samples are presented in Tables 5-9 through 5-12.

As specified in NAVFAC NW's SOP for Navy Environmental Information Transfer, Version 4.0, a copy of the hardcopy laboratory data packages, data validation reports, and field notes will be sent to NAVFAC NW's designee (currently Tetra Tech EC, Inc.) for temporary storage and processing following completion of the 2008 RI. The hardcopy data will then be submitted to the National Archive and Records Administration for 50-year storage.

Also, as specified in NAVFAC NW's SOP for Navy Environmental Information Transfer, Version 4.0, an electronic submittal will be made. Any data qualifiers added by the validation firm will be added to the Analytical Results NEDD. This NEDD, along with NEDDs containing field data will be submitted to URS, Inc., which archives electronic data in the Navy's database, the Navy Installation Restoration Information Solution (NIRIS).

5.6 2008 Investigation Results and Conclusions

This section presents a summary of the MEC and MC data collection activities conducted at each of the AOCs listed as requiring further investigation in Table 5-1 and provides the results of the 2008 investigations.

Note, due to their size, Figures 5-1 through 5-18 are located at the end of Section 5 rather than being integrated with the text. An electronic copy of the GIS database used to generate the figures in this section and the remainder of the RI and FS Reports is provided as Appendix F.

5.6.1 AOC-Specific MEC Investigation Activities and Results

This section provides a review of the MEC investigations at each AOC and presents the findings. Except as noted in the individual descriptions, all MEC investigations were conducted in accordance with the 2008 RI Work Plan and with the DFWs described in Section 5.2. Supporting documentation for the findings described below is provided in the Appendixes A through C.

- Appendix A— Reconnaissance Reports
- Appendix B— Intrusive Summary
- Appendix C— MEC Field Documentation

TABLE 5-9

Analytical Results for Soil Samples

Sample ID			ALDA-01-SL-01		ALDA-01-SL-101		C1-01-SL-01		MI-01-SL-01		MI-01-SL-101		MI-01-SL-201	
Location ID			ALDA-01		ALDA-01		C1-01		MI-01		MI-01		MI-01	
Sample Type			N		FD		N		N		FD		FD	
Sample Date			July 5, 2008		July 5, 2008		July 12, 2008		July 16, 2008		July 16, 2008		July 16, 2008	
Analyte	**Units**	**PSL**												
1,3,5-Trinitrobenzene	mg/kg	180	0.079	U	0.079	U	0.079	U	0.079	U	0.079	U	0.079	U
1,3-Dinitrobenzene	mg/kg	0.58	0.063	U	0.063	U	0.063	U	0.063	U	0.063	U	0.063	U
2,4,6-Trinitrotoluene	mg/kg	3.6	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U
2,4-Dinitrotoluene	mg/kg	0.72	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U
2,6-Dinitrotoluene	mg/kg	0.73	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U
2-Amino-4,6-Dinitrotoluene	mg/kg	0.083	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U
2-Nitrotoluene	mg/kg	2.1	0.066	UJ	0.066	UJ	0.066	UJ	0.066	U	0.066	U	0.066	U
3,5-DNA	mg/kg	-	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U
3-Nitrotoluene	mg/kg	120	0.071	UJ	0.071	UJ	0.071	U	0.071	UJ	0.071	UJ	0.071	UJ
4-Amino-2,6-Dinitrotoluene	mg/kg	0.075	0.075	U	0.075	U	0.075	U	0.075	U	0.075	U	0.075	U
4-Nitrotoluene	mg/kg	29	0.095	U	0.095	U	0.095	U	0.095	U	0.095	U	0.095	U
HMX	mg/kg	60	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U
Nitrobenzene	mg/kg	2	0.075	UJ	0.075	UJ	0.075	U	0.075	UJ	0.075	UJ	0.075	UJ
Nitroglycerin	mg/kg	0.61	0.085	U	0.085	U	0.085	U	0.085	U	0.085	U	0.085	U
Perchlorate	mg/kg	5.5	--		--		--		0.002	U	0.002	U	0.002	U
PETN	mg/kg	-	0.579	U	0.579	U	0.579	U	0.579	U	0.579	U	0.579	U
RDX	mg/kg	4.4	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U
Tetryl	mg/kg	24	0.091	U	0.091	U	0.091	U	0.091	U	0.091	U	0.091	U

-- not analyzed

bold font indicates detected result

Qualifiers

U = The analyte was analyzed for, but not detected.

UJ = The analyte was not detected at or above the method detection limit (MDL), and the reported MDL and practical quantitation limit (PQL) were considered as estimated values.

TABLE 5-9

Analytical Results for Soil Samples

Sample ID		MI-02-SL-01		MI-03-SL-01		MI-03-SL-02		OBOD-01-SL-01		OBOD-01-SL-02		OBOD-01-SL-03	
Location ID		MI-02		MI-03		MI-03		OB0D-01		OB0D-01		OBOD-01	
Sample Type		N		N		N		N		N		N	
Sample Date		July 17, 2008		July 10, 2008		July 18, 2008		July 19, 2008		July 22, 2008		July 10, 2008	
Analyte	**Units**												
1,3,5-Trinitrobenzene	mg/kg	0.079	U	0.079	U	0.079	U	0.079	U	0.079	U	0.079	U
1,3-Dinitrobenzene	mg/kg	0.063	U	0.063	U	0.063	U	0.063	U	0.063	U	0.063	U
2,4,6-Trinitrotoluene	mg/kg	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U
2,4-Dinitrotoluene	mg/kg	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U
2,6-Dinitrotoluene	mg/kg	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U
2-Amino-4,6-Dinitrotoluene	mg/kg	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U
2-Nitrotoluene	mg/kg	0.066	U	0.066	UJ	0.066	U	0.066	U	0.066	U	0.066	UJ
3,5-DNA	mg/kg	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U
3-Nitrotoluene	mg/kg	0.071	UJ	0.071	U	0.071	UJ	0.071	UJ	0.071	U	0.071	U
4-Amino-2,6-Dinitrotoluene	mg/kg	0.075	U	0.075	U	0.075	U	0.075	U	0.075	U	0.075	U
4-Nitrotoluene	mg/kg	0.095	U	0.095	U	0.095	U	0.095	U	0.095	U	0.095	U
HMX	mg/kg	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U
Nitrobenzene	mg/kg	0.075	UJ	0.075	U	0.075	UJ	0.075	UJ	0.075	U	0.075	U
Nitroglycerin	mg/kg	0.085	U	0.085	U	0.085	U	0.085	U	**0.52**		0.085	U
Perchlorate	mg/kg	0.002	U	0.002	U	0.002	U	0.002	U	0.002	U	0.002	U
PETN	mg/kg	0.579	U	0.579	U	0.579	U	0.579	U	0.579	U	0.579	U
RDX	mg/kg	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U
Tetryl	mg/kg	0.091	U	0.091	U	0.091	U	0.091	U	0.091	U	0.091	U

-- not analyzed

bold font indicates detected result

Qualifiers

U = The analyte was analyzed for, but not dete

UJ = The analyte was not detected at or above

TABLE 5-9

Analytical Results for Soil Samples

Sample ID		**OBOD-01-SL-103**		**OBOD-01-SL-203**		**RR-02-SL-01**		**SA93-01-SL-01**		**SA93-01-SL-02**		**SA93-03-SL-01**	
Location ID		OBOD-01		OBOD-01		RR-02		SA93-01		SA93-01		SA93-03	
Sample Type		FD		FD		N		N		N		N	
Sample Date		July 10, 2008		July 10, 2008		July 18, 2008		July 4, 2008		July 4, 2008		July 11, 2008	
Analyte	**Units**												
1,3,5-Trinitrobenzene	mg/kg	0.079	U	0.079	U	0.079	U	0.079	U	0.079	U	0.079	U
1,3-Dinitrobenzene	mg/kg	0.063	U	0.063	U	0.063	U	0.063	U	0.063	U	0.063	U
2,4,6-Trinitrotoluene	mg/kg	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U
2,4-Dinitrotoluene	mg/kg	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U
2,6-Dinitrotoluene	mg/kg	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U
2-Amino-4,6-Dinitrotoluene	mg/kg	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U
2-Nitrotoluene	mg/kg	0.066	UJ	0.066	UJ	0.066	U	0.066	UJ	0.066	UJ	0.066	UJ
3,5-DNA	mg/kg	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U
3-Nitrotoluene	mg/kg	0.071	U	0.071	U	0.071	UJ	0.071	UJ	0.071	UJ	0.071	U
4-Amino-2,6-Dinitrotoluene	mg/kg	0.075	U	0.075	U	0.075	U	0.075	U	0.075	U	0.075	U
4-Nitrotoluene	mg/kg	0.095	U	0.095	U	0.095	U	0.095	U	0.095	U	0.095	U
HMX	mg/kg	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U
Nitrobenzene	mg/kg	0.075	U	0.075	U	0.075	UJ	0.075	UJ	0.075	UJ	0.075	U
Nitroglycerin	mg/kg	0.085	U	0.085	U	0.085	U	0.085	U	0.085	U	0.085	U
Perchlorate	mg/kg	0.002	U	0.002	U	0.002	U	0.002	U	0.002	U	0.002	U
PETN	mg/kg	0.579	U	0.579	U	0.579	U	0.579	U	0.579	U	0.579	U
RDX	mg/kg	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U
Tetryl	mg/kg	0.091	U	0.091	U	0.091	U	0.091	U	0.091	U	0.091	U

-- not analyzed

bold font indicates detected result

Qualifiers

U = The analyte was analyzed for, but not dete

UJ = The analyte was not detected at or above

TABLE 5-10

Analytical Results for Sediment Samples

Sample ID			ALDA-02-SD-01		RR-01-SD-01		RR-04-SD-01		RR-04-SD-02		RR-04-SD-101		SA93-01-SD-01		SA93-02-SD-01	
Location ID			ALDA-02		RR-01		RR-04		RR-04		RR-04		SA93-01		SA93-02	
Sample Type			N		N		N		N		FD		N		N	
Sample Date			July 5, 2008		July 9, 2008		July 9, 2008		July 9, 2008		July 9, 2008		June 28, 2008		June 28, 2008	
Analyte	**Units**	**PSL**														
1,3,5-Trinitrobenzene	mg/kg	0.24	0.079	U	0.079	U	0.079	U	0.079	U	0.079	U	0.13	U	0.11	U
1,3-Dinitrobenzene	mg/kg	0.67	0.063	U	0.063	U	0.063	U	0.063	U	0.063	U	0.1	U	0.085	U
2,4,6-Trinitrotoluene	mg/kg	9.2	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U	0.13	U	0.11	U
2,4-Dinitrotoluene	mg/kg	410	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U	0.13	U	0.11	U
2,6-Dinitrotoluene	mg/kg	200	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U	0.13	U	0.11	U
2-Amino-4,6-Dinitrotoluene	mg/kg	59	0.083	U	0.083	U	0.083	U	0.083	U	0.083	U	0.13	U	0.11	U
2-Nitrotoluene	mg/kg	25	0.066	UJ	0.066	UJ	0.066	UJ	0.066	UJ	0.066	UJ	0.11	UJ	0.089	UJ
3,5-DNA	mg/kg	-	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.13	U	0.11	U
3-Nitrotoluene	mg/kg	4100	0.071	UJ	0.071	U	0.071	U	0.071	U	0.071	U	0.12	UJ	0.096	UJ
4-Amino-2,6-Dinitrotoluene	mg/kg	-	0.075	U	0.075	U	0.075	U	0.075	U	0.075	U	0.12	U	0.1	U
4-Nitrotoluene	mg/kg	360	0.095	U	0.095	U	0.095	U	0.095	U	0.095	U	0.15	UJ	0.13	UJ
HMX	mg/kg	0.47	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.13	U	0.11	U
Nitrobenzene	mg/kg	11	0.075	UJ	0.075	U	0.075	U	0.075	U	0.075	U	0.12	UJ	0.1	UJ
Nitroglycerin	mg/kg	20	0.085	U	0.085	U	0.085	U	0.085	U	0.085	U	0.14	U	0.11	U
Perchlorate	mg/kg	140	--		0.002	U	0.002	U	0.002	U	0.002	U	0.0033	U	0.0027	U
PETN	mg/kg	-	0.579	U	0.579	U	0.579	U	0.579	U	0.579	U	0.94	U	0.78	U
RDX	mg/kg	0.08	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.13	U	0.11	U
Tetryl	mg/kg	820	0.091	U	0.091	U	0.091	U	0.091	U	0.091	U	0.15	U	0.12	U

-- not analyzed

bold font indicates detected result

Qualifiers

U = The analyte was analyzed for, but not detected.

UJ = The analyte was not detected at or above the method detection limit (MDL), and the reported MDL and practical quantitation limit (PQL) were considered as estimated values.

TABLE 5-11

Analytical Results for Groundwater Samples

Sample ID			MI-02-GW-01		MI-02-GW-02		RR-04-GW-01		RR-04-GW-02		RR-04-GW-03		RR-04-GW-04		RR-04-GW-05		RR-04-GW-06		RR-04-GW-103	
Location ID			MI-02		MI-02		RR-04		RR-04		RR-04		RR-04		RR-04		RR-04		RR-04	
Sample Type			N		N		N		N		N		N		N		N		FD	
Sample Date			July 18, 2008		July 17, 2008		July 14, 2008		July 14, 2008		July 15, 2008		July 15, 2008		July 15, 2008		July 16, 2008		July 15, 2008	
Analyte	**Units**	**PSL**																		
1,3,5-Trinitrobenzene	ug/L	120	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U
1,3-Dinitrobenzene	ug/L	-	0.131	U	0.131	U	0.131	U	0.131	U	0.131	U	0.131	U	0.131	U	0.131	U	0.131	U
2,4,6-Trinitrotoluene	ug/L	14	0.133	U	0.133	U	0.133	U	0.133	U	0.133	U	0.133	U	0.133	U	0.133	U	0.133	U
2,4-Dinitrotoluene	ug/L	-	0.125	U	0.125	U	0.125	U	0.125	U	0.125	U	0.125	U	0.125	U	0.125	U	0.125	U
2,6-Dinitrotoluene	ug/L	-	0.125	U	0.125	U	0.125	U	0.125	U	0.125	U	0.125	U	0.125	U	0.125	U	0.125	U
2-Amino-4,6-Dinitrotoluene	ug/L	-	0.125	U	0.125	U	0.125	U	0.125	U	0.125	U	0.125	U	0.125	U	0.125	U	0.125	U
2-Nitrotoluene	ug/L	-	0.126	U	0.126	U	0.126	U	0.126	U	0.126	U	0.126	U	0.126	U	0.126	U	0.126	U
3,5-DNA	ug/L	650	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U
3-Nitrotoluene	ug/L	-	0.133	U	0.133	U	0.133	U	0.133	U	0.133	U	0.133	U	0.133	U	0.133	U	0.133	U
4-Amino-2,6-Dinitrotoluene	ug/L	-	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
4-Nitrotoluene	ug/L	-	0.133	U	0.133	U	0.133	U	0.133	U	0.133	U	0.133	U	0.133	U	0.133	U	0.133	U
HMX	ug/L	-	0.115	U	0.115	U	0.115	U	0.115	U	0.115	U	0.115	U	0.115	U	0.115	U	0.115	U
Nitrobenzene	ug/L	-	0.126	U	0.126	U	0.126	U	0.126	U	0.126	U	0.126	U	0.126	U	0.126	U	0.126	U
Nitroglycerin	ug/L	60	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U
Perchlorate	ug/L	-	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
PETN	ug/L	-	0.607	U	0.607	U	0.607	U	0.607	U	0.607	U	0.607	U	0.607	U	0.607	U	0.607	U
RDX	ug/L	2360	0.123	U	0.123	U	0.123	U	0.123	U	0.123	U	0.123	U	0.123	U	0.123	U	0.123	U
Tetryl	ug/L	-	0.133	U	0.133	U	0.133	U	0.133	U	0.133	U	0.133	U	0.133	U	0.133	U	0.133	U

-- not analyzed

bold font indicates detected result

Qualifiers

U = The analyte was analyzed for, but not detected.

UJ = The analyte was not detected at or above the method detection limit (MDL), and the reported MDL and practical quantitation limit (PQL) were considered as estimated values.

TABLE 5-12

Analytical Results for Surface Water Samples

Sample ID			RR-04-SW-01	RR-04-SW-101	SA93-01-SW-01	SA93-02-SW-01
Location ID			RR-04	RR-04	SA93-01	SA93-02
Sample Type			N	FD	N	N
Sample Date			July 9, 2008	July 9, 2008	June 28, 2008	June 28, 2008
Analyte	**Units**	**PSL**				
1,3,5-Trinitrobenzene	ug/L	120	0.13 U	0.13 U	0.13 U	0.13 U
1,3-Dinitrobenzene	ug/L	-	0.131 U	0.131 U	0.131 U	0.131 U
2,4,6-Trinitrotoluene	ug/L	14	0.133 U	0.133 U	0.133 U	0.133 U
2,4-Dinitrotoluene	ug/L	-	0.125 U	0.125 U	0.125 U	0.125 U
2,6-Dinitrotoluene	ug/L	-	0.125 U	0.125 U	0.125 U	0.125 U
2-Amino-4,6-Dinitrotoluene	ug/L	-	0.125 U	0.125 U	0.125 U	0.125 U
2-Nitrotoluene	ug/L	-	0.126 U	0.126 U	0.126 U	0.126 U
3,5-DNA	ug/L	650	0.13 U	0.13 U	0.13 U	0.13 U
3-Nitrotoluene	ug/L	-	0.133 U	0.133 U	0.133 U	0.133 U
4-Amino-2,6-Dinitrotoluene	ug/L	-	0.1 U	0.1 U	0.1 U	0.1 U
4-Nitrotoluene	ug/L	-	0.133 U	0.133 U	0.133 U	0.133 U
HMX	ug/L	-	0.115 U	0.115 U	0.115 U	0.115 U
Nitrobenzene	ug/L	-	0.126 U	0.126 U	0.126 U	0.126 U
Nitroglycerin	ug/L	60	0.13 U	0.13 U	0.13 U	0.13 U
Perchlorate	ug/L	-	0.2 U	0.2 U	0.2 U	0.2 U
PETN	ug/L	-	0.607 U	0.607 U	0.607 U	0.607 U
RDX	ug/L	2360	0.123 U	0.123 U	0.123 U	0.123 U
Tetryl	ug/L	-	0.133 U	0.133 U	0.133 U	0.133 U

-- not analyzed

bold font indicates detected result

Qualifiers

U = The analyte was analyzed for, but not detected.

UJ = The analyte was not detected at or above the method detection limit (MDL), and the reported MDL and practical quantitation limit (PQL) were considered a

5.6.1.1 ALDA-01

ALDA-01 Crater

The 2008 field work to fill MEC data gaps at ALDA-01 was completed as planned. The instrument-aided mag and dig evaluation of the craters was conducted on August 12, 2008. Figure 5-1 shows the locations of the craters. Forty-three anomalies in the craters were intrusively investigated and only non-munitions related metal debris was found. Photographs of the items found in the craters are included in Appendix A16.

In addition to the planned work for ALDA-01, several MEC investigation tasks associated with ALSW-01, north of ALDA-01, extended into ALDA-01. These activities included a 100 percent DGM survey of a 30-m by 30-m grid at a suspected small arms burial area (Grid 12) and instrument-aided reconnaissance to determine the extent of metal saturation in the subsurface along the seawall berm west of the Andrew Lake Spillway (see Appendix A). Approximately 50 percent of Grid 12 was located in ALDA-01. Limited intrusive investigation of anomalies at Grid 12 (see Section 5.6.1.3 below) encountered large non-munitions-related metal debris apparently used in enhancement and extension of a naturally occurring barrier beach or spit to create the seawall between Andrew Bay and Andrew Lake. For the site reconnaissance, a Whites XLT was used to identify buried metal and an RTK DGPS unit was used to determine location. The apparent western edge of densely clustered metal anomalies was found in ALDA-02, approximately 550 feet northwest of Grid 12. Anomaly density appeared to be greater nearest the shoreline, but large numbers of anomalies were still found along the southern pathway for the transect. The reconnaissance transect is shown on Figure 5-1. Items found in ALDA-01 during the course of the intrusive investigation at Grid 12 and the western transect included non-munitions-related metal debris, cables, angle irons, and other debris; no MEC items were found. The MEC finds depicted near the center of ALDA-01 on Figure 5-1 consist of UXO and DMM that were collected outside of OU B-2 and placed in ALDA-01 for later pickup and disposal. The items did not originate in ALDA-01.

5.6.1.2 ALDA-02

The MEC NOFA determination for ALDA-02 was completed using previously collected information; no additional data collection was planned for 2008. However, the northern portion of ALDA-02 was included in the instrument-aided reconnaissance for the western portion of ALSW-01 (see Figure 5-2 and Section 5.4.1.3 below). The apparent western edge of buried metal was found in ALDA-02, approximately 100 feet beyond its western boundary with ALDA-01 (Appendix A). No MEC was found on the surface or in the subsurface (see Table 5-13 below).

5.6.1.3 ALSW-01

The 2008 field work to fill MEC data gaps at ALSW-01 was completed with several modifications to allow for conditions encountered in the field. These conditions included discrepancies in AOC boundaries relative to the shoreline and the presence of large non-munitions-related metal debris apparently used in construction of the seawall. The following changes to the planned MEC investigation at the AOC were identified, discussed on August 21, 2008, and approved through the FCR process:

- FCR-01: Adjustment of three planned transect routes to the south so that they followed the portion of the seawall between Andrew Lake and the crest of the seawall, rather than being on the beach.
- FCR-02: Movement of the 30-m by 30-m grid (Grid 12) at the potential upland small arms burial area by about 10 m to the south so that the survey was conducted in an upland area rather than in water.
- FCR-12 and 14: Changes to the method of characterization at the 30-m by 30-m grid because of DGM data saturation, wherein nine peak anomalies along mutually perpendicular lines were investigated rather than all anomalies.

- FCR-16: Modifications to the fourth transect path for areas west of the spillway so that a random rather than straight path was followed[5].

During the course of the 2008 investigation, over 1,000 anomalies were detected along the three transects located on the seawall and in the 30-m by 30-m grid. Limited intrusive investigation of anomalies encountered large non-munitions-related metal debris apparently used in enhancement and extension of a naturally occurring barrier beach or spit to create the seawall between Andrew Bay and Andrew Lake. The debris could not be removed with available tools or without possibly compromising the integrity of the seawall.

Neither MEC items nor evidence of small arms burial were found during the limited intrusive investigation at Grid 12 and no needs for expansion grids were identified. However, since the investigation at Grid 12 could not be completed as planned, an instrument-aided reconnaissance was conducted to determine the extent of the densely clustered anomalies found in the western portion of the AOC. Because the ground surface in the western portion of ALSW-01 and the northern portions of ALDA-01 and ALDA-02 was too rough to allow use of DGM, a Whites XLT was used to identify anomalies and a RTK DGPS unit was used to determine location. The reconnaissance began on the eastern edge of Grid 12 and meandered to the southwest corner of Grid 12 where anomaly densities of one anomaly per foot were identified, then west along the seawall berm to a point where the density declined to about one anomaly per 10 feet. The reconnaissance continued south into ALDA-02 and followed the toe of the slope back to ALDA-01 south of Grid 12. The apparent western edge of densely clustered metal anomalies along the western portion of the seawall was found in ALDA-02, approximately 550 feet northwest of Grid 12. Anomaly density appeared to be greater nearest the shoreline, but large numbers of anomalies were still found south of ALSW-01 in ALDA-01.

Surface conditions observed during the site reconnaissance included the presence of metal, wood, plastic, MD, and other detritus along the shoreline of ALSW-01, within the upland portion of ALSW-01, and in the northern portions of ALDA-01 and ALDA-02. These items appear to have been deposited by surf. Large deposits of non-munitions-related metal debris were also observed in cuts through the seawall berm. Photographs of these features and other reconnaissance details are provided in Appendix A.

The results of the limited intrusive investigation are shown in Figure 5-3 and summarized in Table 5-13.

TABLE 5-13
Summary of 2008 Investigation Findings for ALSW-01

Items Identified	Number	Depth (bgs)		
		Surface	**0 to 0.5 foot**	**0.5 to 2 foot**
UXO	0	0	0	0
DMM	0	0	0	0
MD	4	1	1	2
Other	79	52	14	13

5.6.1.4 C1-01

The Level 2 assessment for C1-01 was conducted using previously collected MEC data. The only additional investigations conducted during 2008 were an accessibility assessment to determine whether further delineation of the impact area beyond the current AOC boundary was feasible (the eastern boundary was of particular concern because UXO had been found outside the boundary during the 1999 SI), and completion of a visual inspection of site features indicative of erosion or instability so as to assess the possibility of migration of MEC beyond AOC boundaries.

5 The FCR indicated that the survey would be conducted using DGM; however, the ground surface was too rough to allow use of the EM61, so a Whites XLT and RTK GPS were used to identify and locate anomalies.

The 2008 field work to fill MEC data gaps at C1-01 was completed as planned. Slopes along the western, northeastern, and eastern boundaries of the AOC were measured and found to be greater than 30 degrees and therefore inaccessible for further delineation using DGM. Photographs of slopes around C1-01 are included in Appendix A.

The reconnaissance for physical features indicative of erosion or site instability was conducted on August 21, 2008. Over 40 possible features including slumped soil, stream channels, unstable slopes, and barren soil were observed at C1-01 (see Appendix B). MD was observed within and near a number of these features, indicating the potential for redistribution of MEC through slumping and/or erosion of soil. However, in most cases, the slumps and erosion features were located in isolated higher elevation areas within the boundary of the AOC and had limited potential for offsite transport of MEC because of their small size and topographic position. The exceptions were several slumps with visible MD located just beyond the mapped eastern boundary of C1-01 in the area where the accessibility survey was conducted. Given the uncertainty about the size of the target/impact area at C1-01, it is more likely that the MD and previously identified MEC items found in the area were fired into the area rather than being transported there by erosion. The results of the reconnaissance at C1-01 were presented during the September 4, 2008, meeting, and it was agreed that no follow-up investigation was required.

5.6.1.5 HG-01

The 2008 field work to fill MEC data gaps at HG-01 was completed as planned. The MEC investigation at HG-01 included intrusive investigation of 25 previously identified anomalies and geophysical and intrusive investigation of two 30-m by 30-m grids centered on two prior MEC discoveries (Grids 9 and 10). The 25 historical targets at HG-01 were found to be MD and non-munitions related waste. Two UXO items (40 mm projectiles) were found in portions of Grid 9 that had been fully investigated and cleared in 1999. The 1999 data for these areas were reviewed and there is no information that indicates why these items were missed.

One UXO item was located on the eastern boundary of Grid 9. However, as agreed upon during the September 4, 2008, meeting, no expansion grids or step-out transects were conducted because no MEC items were found along the adjacent RR-01 transects. All MEC items found at HG-01 were removed and destroyed.

The results of the intrusive investigation are shown in Figure 5-5 and summarized in Table 5-14.

TABLE 5-14
Summary of 2008 Investigation Findings for HG-01

Items Identified	Number	Depth (bgs) Surface	0 to 0.5 foot	0.5 to 2 foot
UXO	2	0	2	0
MD	161	9	146	6
Other	374	21	346	7
Items Found:*				
UXO	40-mm projectile, HE, M406 (2)			

*Information in this table is provided to identify the type and depths of ordnance recovered only. It is not intended to be a formal inventory.

5.6.1.6 MAG-01

The 2008 field work to fill MEC data gaps at MAG-01 had to be modified to account for the presence of heavy vegetation in the southern portion of the AOC. A full inspection of this area would have required several weeks of dedicated vegetation removal. The following change to the planned MEC investigation was identified, discussed on August 21, 2008, and approved through the FCR process:

- FCR-15: Observation of accessible portions of vegetated area by cutting 4-foot-wide paths approximately 8 to 10 feet apart through heavy vegetation and conducting a detector-aided and visual inspection of the area. This allowed approximately 50 percent of the southern portion of the vegetated area to be inspected.

MAG-01 Reconnaissance Area

The instrument-aided visual inspection was conducted between August 28 and September 2, 2008, following vegetation removal. Accessible areas (i.e., slopes of less than 30 degrees and areas not covered by water) in the northern portion of the AOC were fully swept as planned. Several large subsurface anomalies in the southern part of the AOC were determined to be cables and barrels. The majority of the non-munitions-related metal debris was found adjacent to an overgrown road that runs north to south through the center of MAG-01. No evidence of the storage magazine was found during the inspection, and neither MEC items, MD items, nor munitions-related cultural debris were encountered. The results of the inspection at MAG-01 were presented during the September 4, 2008, meeting, and it was agreed that no follow-up investigation was required.

The results of the inspection are detailed in Appendix A and shown in Figure 5-6.

5.6.1.7 MI-01

The 2008 field work to fill MEC data gaps at MI-01 was completed with modifications following completion of the 100 percent geophysical surveys and intrusive investigations at Grids 5 and 6. The initial grid investigations were performed in accordance with the 2008 RI Work Plan, and UXO items were found at the boundaries of the two grids. The Level 2 process for determining the extent of MEC in such circumstances was modified to consist of step-out transects rather than an expansion grid. The following change to the planned MEC investigation was identified, discussed on September 4, 2008, and approved through the FCR process:

- FCR-17: Extent of MEC for east side of Grid 6 will be determined using four 15-meter transects running from east to west. Should MEC items be encountered, the transects will be extended until no MEC items are encountered for 15 meters or the transects are 45 meters long. Additional guidance will be requested if these 45-meter transects do not have 15 meters MEC free on the eastern end.

In addition, during the September 4, 2008, meeting, possible expansion grids/step-out transects for MEC finds along other Grid 5 and 6 boundaries were deferred to remedial action based on similarity in MEC distribution in nearby MI-02 and MI-03.

During the course of the intrusive investigations at Grid 5 and 6, 56 UXO items, 23 MPPEH items, and numerous MD, non-munitions-related metal debris, and scrap items were encountered. About 20 barrels were found scattered across the surface of the AOC. Five additional UXO items were found along the two northern-most step-out transects that extended into MI-03. The eastern limits of UXO were found in accordance with the modified step-out process described in FCR-17. (Note: although four step-out transects were planned, the southern-most transect could not be completed due to steep terrain.) The northern limit of UXO was not determined because similar UXO items had been found along transects and grids in MI-03 and the two AOCs appeared to overlap. All MEC items found at MI-01 were removed and destroyed. The results of the intrusive investigation are shown in Figure 5-7 and summarized in Table 5-15.

TABLE 5-15
Summary of 2008 MEC Investigation Findings for MI-01

		Depth Range (bgs)		
Items Identified	**Number**	**Surface**	**0 to 0.5 feet**	**0.5 to 2 feet**
UXO	54	0	38	16
MD	215	4	187	24
MPPEH	17	0	12	5
Other	71	25	40	6

Items Found:*

UXO	Rifle grenade, HEAT, M9 (13) Rifle grenade, WP, M19 (9) Rifle grenade, WP, M9 Rifle grenade 40-mm projectile, HE M406 40-mm projectile, HE, MKII 2.36-in rocket, HEAT, M6 (26) 3.5-in rocket, HEAT, M28 3.5-in rocket, HEAT, M6
MPPEH	2.36-in rocket motor 3.5-in rocket motor (15) 40-mm projectile MKII w/ self destruct only

*Information in this table is provided to identify the type and depths of ordnance recovered only. It is not intended to be a formal inventory.

5.6.1.8 MI-02

The 2008 field work to fill MEC data gaps at MI-02 was completed with modifications following completion of the 100 percent geophysical surveys and intrusive investigations at Grids 1 through 4. Only MD and non-munitions-related waste were identified in Grids 1 and 2. UXO items were found in Grids 3 and 4, and along one transect. The UXO items in both grids were located along the grid boundary (north side of Grid 3, west side of Grid 4). The use of expansion grids/step-out transects to delineate MEC at these locations was discussed during the September 4, 2008, meeting; further delineation of MEC at Grid 4 was deferred to remedial action based on the proximity of Grid 5 in nearby MI-01, and delineation of MEC on the north side of Grid 3 was to be accomplished by extending Transects 15, 16, and 17 in MI-03 to the boundary of Grid 3. No MEC items were found along Transects 16A and 17A. Transect 15A had to be abandoned because of very wet conditions. All MEC items found at MI-02 were removed and destroyed.

The results of the intrusive investigation are shown in Figure 5-8 and summarized in Table 5-16.

TABLE 5-16
Summary of 2008 MEC Investigation Findings for MI-02

Items Identified	Number	Depth Range (bgs)		
		Surface	0 to 0.5 feet	0.5 to 2 feet
DMM	1	0	1	0
UXO	4	0	4	0
MD	310	NA	NA	NA
MPPEH	6	0	6	0
Other	32	0	14	18
Items Found:*				
DMM	Fuze, projectile, PD, M46			
UXO	2.36-in rocket 2.36-in rocket, HEAT, M6 60-mm mortar HE, M49 75-mm projectile, HE M48			
MPPEH	2.36-inch rocket motors (2) 40-mm projectile Tracer w/self destruct for 40-mm AA (3)			

*Information in this table is provided to identify the type and depths of ordnance recovered only. It is not intended to be a formal inventory.

The reconnaissance for physical features indicative of erosion or site instability at MI-02 was conducted on August 6, 2008. Thirteen possible erosion features, including drainage channels, exposed soil, and slumps, were observed (see Appendix A). The drainage channels and erosion features were located within the boundary of the AOC and had limited potential for offsite transport of MEC because of their small size and topographic position. No MEC or MD items were observed in the vicinity of the features. The results of the reconnaissance at MI-02 were presented during the September 4, 2008, meeting, and it was agreed that no follow-up investigation was required.

5.6.1.9 MI-03

The 2008 field work to fill MEC data gaps at MI-03 was completed with modifications because steep terrain and water features in the western part of the AOC made use of straight line transects infeasible.

The following change to the planned MEC investigation at the AOC was identified, discussed on August 21, 2008, and approved through the FCR process:

- FCR-11: Straight line transect in western portion of MI-03 modified to wandering path transects through accessible portion of area.

Only MD and non-munitions related waste were identified in Grids 7 and 8. One UXO item (i.e., hand grenade) was found along a transect in the east-central portion of the AOC. The item was removed and destroyed. As indicated for MI-02, Transects 16 and 17 in MI-03 were extended to the northern boundary of Grid 3 to provide data for delineation of MEC items found in that grid, and no MEC items were found in Transects 16A, and 17A.

The results of the intrusive investigation are shown in Figure 5-9 and summarized in Table 5-17.

TABLE 5-17
Summary of 2008 MEC Investigation Findings for MI-03

Items Identified	Number	Depth Range (bgs)		
		Surface	0 to 0.5 feet	0.5 to 2 feet
DMM	2	0	1	1
UXO	3	0	0	3
MD	265	1	115	149
MPPEH	0	0	0	0
Other	145	NA	NA	NA
Items Found:*				
DMM	Fuze, rocket, MK131 Fuze, rocket, MK152			
UXO	Grenade, hand, HE, MKI Grenade, hand, HE, MKII 2.36-in rocket, HEAT, M6			

*Information in this table is provided to identify the type and depths of ordnance recovered only. It is not intended to be a formal inventory.

The reconnaissance for physical features indicative of erosion or site instability at MI-03 was conducted on August 13, 2008. Twenty possible features, including drainage channels, exposed soil, and slumps, were observed (see Appendix A). No MEC or MD items were observed in the vicinity of the features. The drainage channels and erosion features were located within the boundary of the AOC and appeared to have limited potential for offsite transport of MEC because of their small size and topographic position. The results of the reconnaissance at MI-03 were presented during the September 4, 2008, meeting, and it was agreed that no follow-up investigation was required.

The instrument-aided visual inspection in the southern portion of MI-03 was conducted on August 23, 2008, following vegetation removal. Accessible areas (i.e., slopes of less than 30 degrees) were fully swept, as indicted in Appendix A. Small pieces of heavy cased munitions were found at the surface, but no craters or other indications of impact were found. The results of the inspection at MI-03 were presented during the September 4, 2008, meeting, and it was agreed that no follow-up investigation was required.

5.6.1.10 OB/OD-01

The Level 2 assessment at OB/OD-01 was conducted using previously collected MEC data. No MEC investigation activities were conducted at OB/OD-01 during 2008. However, JAU-22/B initiators and a non-electric blasting cap were encountered at OB/OD-01 during clearance of MIS grids for soil sampling.

5.6.1.11 RR-01

The 2008 field work to fill MEC data gaps at RR-01 was completed as planned. Over 900 targets along the transects were investigated, with 14 UXO finds, 1 MPPEH find, and numerous MD, non-munitions-related metal debris, rock, and scrap finds. The UXO items were found on the interior of the former target/impact area or along the base of steep slopes so no expansion grids or step-out transects were performed. Two targets were identified as having sources below 2 feet, as indicated in Figure 5-11.

The results of the intrusive investigation are shown in Figure 5-11 and summarized in Table 5-18.

TABLE 5-18
Summary of 2008 MEC Investigation Findings for RR-01

Items Identified	Number	Depth Range (bgs) Surface	0 to 0.5 feet	0.5 to 2 feet
UXO	13	0	13	0
MD	400	3	292	105
MPPEH	1	0	1	0
Other	389	36	243	110
Items Found:*				
UXO	2.36-in rocket HEAT, M6 (4) 40-mm projectile, HE, MKII (2) 40-mm projectile, HE, M406 (3) 40-mm projectile, HEDP, M433 40-mm projectile, HE, M397 40-mm projectile, HE, MK 3 5-in rocket, APHE, MK 34			
MPPEH	2.36-in rocket motor			

*Information in this table is provided to identify the type and depths of ordnance recovered only. It is not intended to be a formal inventory.

The reconnaissance for physical features indicative of erosion or site instability was conducted on August 20, 2008. Two slumps were identified on the steep valley wall that borders the south side of the AOC (see Appendix A), and the stream banks along Moffett Creek were observed to be actively eroding at numerous locations. No MEC or MD items were observed in the vicinity of the slumps or the eroding banks. The slumps were located within the boundary of the AOC and appeared to have limited potential for offsite transport of MEC because of their small size and topographic position. The results of the reconnaissance at RR-01 were presented during the September 4, 2008, meeting, and it was agreed that no follow-up investigation was required.

The instrument-aided visual inspection focused on a relatively flat area atop the valley wall on the south side of RR-01 and was conducted on August 25, 2008. Accessible areas (i.e., slopes of less than 30 degrees) were fully swept with a Whites XLT, as indicted in Appendix A. Small pieces of heavy cased munitions and metal frames were found at the surface, but no craters or other indications of impact were found. The results of the inspection at RR-01 were presented during the September 4, 2008, meeting, and it was agreed that no follow-up investigation was required.

5.6.1.12 RR-02

The 2008 field work to fill MEC data gaps at RR-02 was completed as planned. Over 370 targets were identified for investigation along the transects, and no MEC items were found.

The results of the intrusive investigation are shown in Figure 5-12 and summarized in Table 5-19.

TABLE 5-19
Summary of 2008 MEC Investigation Findings for RR-02

Items Identified	Number	Depth Range (bgs) Surface	0 to 0.5 feet	0.5 to 2 feet
UXO	0	0	0	0
MD	278	130	140	8
MPPEH	0	0	0	0
Other	61	40	16	5

Instrument-aided visual inspections were conducted in the northeastern and southwestern portions of the AOCs to determine whether further geophysical and intrusive investigations were required in these areas. The northeastern area was inspected on August 29, 2008, and a few .30 caliber projectiles were found. The southwestern portion of the AOC was inspected on August 5 and 6, 2008, and tail fins from 81-mm illumination mortars, remnants of expended M48 series PD fuzes, and fragments of unknown munitions were identified (see Appendix A). The presence of these items was discussed in the September 4, 2008, meeting, with the recommendation that a follow-up DGM survey be conducted in the vicinity of the MD and MPPEH finds. Four geophysical transects (X1 through X4) spaced at 34.5 m were subsequently surveyed through the area in October 2008, and no targets were identified for intrusive investigation.

5.6.1.1 RR-03

RR-03 was classified as a NOFA site in the RI Work Plan. However, prior to the onset of the 2008 field activities, there was a discussion about identifying and surveying the obstacles that prevented full survey of the AOC in 1999 and 2000. These discussions eventually concluded that such work was not required.

5.6.1.2 RR-04

The 2008 field work to fill MEC data gaps at RR-04 was completed as planned. One hundred and twenty-seven targets were investigated and no MEC items were found. The majority of the items found were non-munitions-related metal debris. A degraded 55-gallon drum was found at anomaly RR04T1007 along the southern transect. The drum was lying on its side just beneath the layer of grass, with a six-inch long hole on its upper surface where the technician's shovel had penetrated. The drum appeared to be about half full of tar, grease or a similar highly viscous petroleum product. The material in the drum appeared to be too thick to seep out of the container and the soil around the drum was not stained, so the drum was left in place at the direction of the NTR. The drum and its contents will be addressed during the OU B-2 remedial action.

The results of the intrusive investigation are shown in Figure 5-13 and summarized in Table 5-20.

TABLE 5-20
Summary of 2008 MEC Investigation Findings for RR-04

		Depth Range (bgs)		
Items Identified	**Number**	**Surface**	**0 to 0.5 feet**	**0.5 to 2 feet**
UXO	0	0	0	0
MD	11	1	10	0
MPPEH	0	0	0	0
Other	36	14	18	4

The instrument-aided visual inspection of the ridge on the southern side of RR-04 was conducted on August 28, 2008. A few pieces of heavy-cased munitions were found, but there was nothing to indicate impacts or detonations in the area (see Appendix A). The observations were discussed during the September 4, 2008, meeting, and it was agreed that no follow-up investigation was required.

5.6.1.3 SA-01

The 2008 field work to fill MEC data gaps at SA-01 was completed as planned. Consistent with the use of the area for small arms training, only 0.30 and 0.50 caliber projectiles were found; no UXO or MPPEH were identified in the grid or in the reconnaissance area.

The results of the investigation are shown in Figure 5-14 and summarized in Table 5-21.

TABLE 5-21
Summary of 2008 MEC Investigation Findings for SA-01

Items Identified	Number	Depth Range (bgs)		
		Surface	0 to 0.5 feet	0.5 to 2 feet
UXO	0	0	0	0
MD	64	6	50	8
MPPEH	0	0	0	0
Other	0	0	0	0

The instrument-aided visual inspection at SA-01 was conducted on August 15, 2008. Large scrap items and vehicles were found at the surface, but no MEC items, MD items, or munitions-related cultural debris were found in the area (see Appendix A). All indications were that the area was used for small arms training. The observations were discussed during the September 4, 2008, meeting, and it was agreed that no follow-up investigation was required.

5.6.1.4 SA93-01

The 2008 field work to fill MEC data gaps at SA93-01 was completed with modifications following completion of the transects and the 100 percent geophysical survey and intrusive investigations at Grid 13. Items found in SA93-01 were consistent with use of the area as a target impact area, with multiple mortars, projectiles, and rockets found along a northwest/southeast alignment crossing through the AOC. The results of the intrusive investigation are shown in Figure 5-15 and summarized in Table 5-22. Several MEC items were found along the edges of Grid 13, and the possible use of expansion grids/step-out transects to delineate MEC at Grid 13 was discussed during the September 4, 2008, meeting. Further delineation of MEC was deferred to remedial action based on the similarities in MEC distribution within SA93-01 and in Grid 14 at SA93-03 and terrain considerations. All MEC items found along transects and the grid were removed and destroyed.

TABLE 5-22
Summary of 2008 MEC Investigation Findings for SA93-01

Items Identified	Number	Depth Range (bgs)			
		Surface	0 to 0.5 feet	0.5 to 2 feet	2 to 4 feet
UXO	29	3	14	11	1
DMM	1	0	1	0	0
MD	373	11	248	114	0
MPPEH	2	0	2	0	0
Other	143	20	98	25	0

Items Found:*

DMM	Fuze, PD, M48 series	
UXO	2.36-in rocket, HEAT, M6 (3) 37-mm projectile, HE, M63 37-mm projectile, HE, MK II 60-mm mortar, illum., M83 81-mm mortar, WP 81-mm mortar, WP, M370 75-mm projectile, HEAT, T39 (2)	76-mm projectile, APHE, M62 37-mm projectile, HE, M63 37-mm projectile, HE, MK II 57-mm projectile, HEAT, M307 (12) 75-mm projectile, HE, M48 (2) 75-mm projectile, HEAT, T39 (2) 75-mm projectile, WP, M311
MPPEH	2.36-in rocket motor Signal, illumination, ground M19A	

*Information in this table is provided to identify the type and depths of ordnance recovered only. It is not intended to be a formal inventory.

Slopes in the previously-uninvestigated areas along the western and eastern margins of the AOC were measured and found to be greater than 30 degrees and therefore inaccessible for further delineation using DGM.

The reconnaissance for physical features indicative of erosion or site instability was conducted on August 20, 2008. Fourteen possible erosion features, including slumped soil and a drainage channel, were observed at SA93-01 (see Appendix A). Neither MEC nor MD was observed within or near these features, which were mostly located on the steep slopes overlooking the AOC. Because of topography, any MEC eroded from these areas would only be transported a short distance and be deposited within lower portion of the AOC. The results of the reconnaissance at SA93-01 were presented during the September 4, 2008, meeting, and it was agreed that no follow-up investigation was required.

5.6.1.5 SA93-02

The 2008 field work to fill MEC data gaps at SA93-02 was completed as planned. The instrument-aided visual inspection at SA93-02 was conducted on July 28, 2008. An artillery lifting lug and an expended M48 series fuze were found during the reconnaissance (see Appendix A and Figure 5-16). No evidence of impact or detonations was found. The reconnaissance for physical features indicative of erosion or site instability was conducted on August 20, 2008. Eight potential erosion features were identified, including slumped and exposed soils along the ravine drained by Mitchell Creek. None of the features was sufficiently large or suitably placed to allow erosion and offsite transport of MEC and no MEC or MD items were observed in the vicinity. Conditions observed at the AOC during the inspection and reconnaissance were discussed during the September 4, 2008, meeting, and no follow-up actions were identified.

5.6.1.6 SA93-03

The 2008 field work to fill MEC data gaps at SA93-03 was completed with modifications to account for conditions encountered in the field.

Items found at Grid 14 in SA93-03 were consistent with use of the area as a target impact area, with 2.36-inch rockets and rocket motors found along a northwest/southeast alignment crossing through the AOC into SA93-01 to the west. UXO items were also found along the eastern and southern edges of Grid 14. The use of step-out transects to delineate the limits of MEC at SA93-03 was discussed during the September 4, 2008, meeting. Step-out transects were proposed for the southern and eastern edges of the grid, but additional delineation of MEC on the west side of the grid was deferred to remedial action due to similarities in MEC occurrence between SA93-01 and SA93-03. No MEC items were found in the step-out transects on the eastern and southern sides of Grid 14. All MEC items found in the grid were removed and destroyed.

The results of the intrusive investigation are shown in Figure 5-17 and summarized in Table 5-23.

TABLE 5-23
Summary of 2008 MEC Investigation Findings for SA93-03

		Depth Range (bgs)		
Items Identified	**Number**	**Surface**	**0 to 0.5 feet**	**0.5 to 2 feet**
UXO	11	2	4	5
MD	37	4	15	18
MPPEH	4	0	3	1
Other	59	34	17	8
Items Found:*				
UXO	2.36-in rocket 2.36-in rocket, M7/A4 2.36-in rocket, HEAT, M6 (8) 2.36-in rocket, practice			
MPPEH	2.36-in rocket motor (2) 2.36-in rocket, practice projectile, 37-mm, AP			

*Information in this table is provided to identify the type and depths of ordnance recovered only. It is not intended to be a formal inventory.

5.6.1.7 SA93-04

The 2008 field work to fill MEC data gaps at SA93-04 was completed as planned. The instrument-aided visual inspection was conducted on July 28, 2008. The entire area was screened with a Whites XLT, as described in Appendix A. No MEC or MD items were found. The only surface anomalies encountered were two expended shotgun shells and a pull tab. Minor subsurface anomalies were detected, but given the small size of the AOC and the types of items found at the surface, they were not intrusively investigated. The results of the investigation are shown in Figure 5-18. Conditions observed at the AOC during the inspection were discussed during the September 4, 2008, meeting, and no follow-up actions were identified.

5.6.2 AOC-Specific MC Investigation Activities and Results

This section provides a review of the MC investigations at each AOC and presents the findings. Except as noted in the individual descriptions, all MC investigations were conducted in accordance with the 2008 RI Work Plan and with the DFWs described in Section 5.3. Sample locations are shown in Figures 5-1 through 5-18. Sample collection information is provided in Table 5-8 and analytical results for the samples are listed in Tables 5-9 through 5-12. Additional supporting documentation for the findings described below is provided in the following appendices:

- Appendix D: MC Field Documentation
- Appendix E: Laboratory Analytical Data and Validation Reports

5.6.2.1 ALDA-01

The 2008 field work to fill MC data gaps at ALDA-01 was completed as planned. A single three-point composite sample was planned at ALDA-01. The soil sample was collected as proposed from the largest crater surveyed (Figure 5-1). A field duplicate sample was also collected at the parent sample location to fulfill QA/QC requirements. The sample crater measured approximately 43 feet in diameter and was approximately 13 feet deep. Soil present in the crater was observed to be dark brown, soft, moist organic silt with abundant organic material (e.g., roots). Additional sample information, including sample identification number, depth, sample date, and target analytes, is listed for this and other AOCs in Table 5-8. Concentrations of all target analytes were below detection limits in the soil sample (Table 5-9).

5.6.2.2 ALDA-02

The 2008 field work to fill MC data gaps at ALDA-02 was completed as planned. The planned five-point composite sediment sample was collected from the bed of the stream that originates in C1-01. This stream flows to the north through ALDA-02 into Andrew Bay.

The sediment sample collected at ALDA-02-SD-01 consisted of five subsamples obtained where sediment was present in the stream bed as shown in Figure 5-2. The sediments collected at ALDA-02 were observed to be either a soft, saturated, brownish-gray silt or a loose, saturated, orangish-brown, medium to fine gravel with coarse sand.

Additional sample information, including sample identification number, depth, sample date, and target analytes, is listed in Table 5-8. Concentrations of all target analytes were below detection limits in the sediment sample. Sample results are summarized in Table 5-10.

ALDA-02-SD-01 Sediment Sample Location

5.6.2.3 ALSW-01

No breached items were found during the intrusive investigations at ALSW-01; thus no MIS soil samples were collected and no analytical results were reported.

5.6.2.4 C1-01

The 2008 field work to fill MC data gaps at C1-01 was completed as planned. Soil sample C1-01-SL-01 was collected by constructing a 50-foot by 50-foot, 5- by 6-unit MIS sample grid centered on the previously identified breached items location at anomaly C1-01-036. The C1-01-SL-01 MIS sample grid was oriented with the top of the grid facing northeast due to uneven terrain features and a 3- to 4-foot depression along the southeastern edge of the MIS grid. The northern quadrant of each grid cell was randomly selected for collection of subsamples using a random number generator. The soil collected at C1-01-SL-01 was observed to be dark brown, soft, moist, fine organic silt. No additional breached items or areas of suspected MC were found during the reconnaissance at C1-01; thus no additional MIS soil samples were collected.

The sample location is shown in Figure 5-4. Information about the sample is summarized in Table 5-8. Concentrations of all target analytes in the soil sample were below detection limits. Sample results are summarized in Table 5-9.

5.6.2.5 HG-01

No breached items were found during the intrusive investigations at HG-01; thus no MIS soil samples were collected and no analytical results were reported.

5.6.2.6 MAG-01

No sampling was proposed at MAG-01 in the 2008 RI Work Plan.

5.6.2.7 MI-01

The 2008 field work to fill MC data gaps at M1-01 was completed as planned. The MIS soil samples collected at MI-01-SL-01 (including duplicate sample MI-01-SL-101 and triplicate sample MI-01-SL-201) were collected by constructing a 10-foot by 10-foot, 5- by 6-unit MIS sample grid centered on the previously identified rocket location (MI-01-030). The MIS sample grid was oriented with the top of the grid facing north. The southwest quadrant of each grid cell was randomly selected for collection of the parent (MI-01-SL-01) subsamples using a random number generator.

Subsamples for the duplicate and triplicate samples (MI-01-SL-101 and MI-01-SL-201) were collected from the southeast and northeast quadrants, respectively. The soil collected at MI-01-SL-01 was dark brown, soft, moist, fine organic silt.

The sample location is shown in Figure 5-7. Information about the samples is summarized in Table 5-8. Concentrations of all target analytes were below detection limits in the soil samples. Sample results are summarized in Table 5-9.

5.6.2.8 MI-02

The 2008 field work to fill MC data gaps at M1-01, including collection of conditional groundwater samples from seeps along the valley walls, was completed as planned.

The MIS soil sample collected at MI-02-SL-01 was collected by constructing a 50-foot by 50-foot, 5- by 6-unit MIS sample grid centered on the previously identified breached items location at anomaly MI-09-006. The MI-02-SL-01 MIS sample grid was oriented with the top of the grid facing north. The southeastern quadrant of each grid cell was randomly selected for collection of subsamples using a random number generator. The soil collected at MI-02-SL-01 was dark brown, soft, moist, fine organic silt with significant roots. No breached items were found during the intrusive investigations, so no additional MIS soil samples were collected.

Groundwater seep samples MI-02-GW-01 and MI-02-GW-02 were collected from locations where groundwater was observed to be seeping and beginning to flow over the ground surface. Groundwater at MI-02-GW-01 was observed to be slowly seeping from the hillside with notable saturated soils and wetland vegetation downhill/downstream of the groundwater seep. The groundwater within the seep pool was observed to be clear, cold, low- to medium-turbidity, and flowing very slowly. Groundwater at MI-02-GW-02 was observed to be rapidly seeping from the downhill toe of the outcropping hill within the valley with notable saturated soil, flowing streamlets, and wetland vegetation downhill/downstream of the groundwater seep. A natural seep pool already existed and no expansion of the pool was necessary for sample collection.

The sample locations are shown in Figure 5-8. Information about the samples is summarized in Table 5-8. Concentrations of all target analytes were below detection limits in all samples. Sample results are summarized in Tables 5-9 and 5-11.

5.6.2.9 MI-03

The 2008 field work to fill MC data gaps at M1-03 was completed as planned. However, one deviation from laboratory procedures in the MC QAPP was required because MIS soil sample MI-03-SL-01 could not be air-dried sufficiently in time to allow grinding and sieving under 8830B laboratory processing procedure within the required holding time. Consequently, the sample was analyzed using standard Method 8330 protocols (no grinding or sieving), including correction for moisture content. This change was documented in FCR-13.

MIS soil sample MI-03-SL-01 was collected by constructing a 50-foot by 50-foot, 5- by 6-unit MIS sample grid centered on the previously identified breached items location southeast of soil sample MI-02-SL-02. The MI-03-SL-01 MIS sample grid was oriented with the top of the grid facing north. The northwestern quadrant of each grid cell was randomly selected for collection of subsamples using a random number generator. The MI-03-SL-01 MIS sample grid was located within an apparent wetland zone with significant standing water at the vegetative surface, soft “spongy” ground, and observable wetland vegetation. The soil collected at MI-03-SL-01 was observed to be dark brown, very soft, wet, fine organic silt.

MIS soil sample MI-03-SL-02 was collected by constructing a 10-foot by 10-foot, 5- by 6-unit MIS sample grid centered on the previously identified breached items located at anomaly MI-130-20. The MI-03-SL-02 MIS soil sample grid was oriented with the top of the grid facing northeast due to a 3- to 4-foot elevated soil ledge traversing through the MIS sample grid. The western quadrant of each grid cell was randomly selected for collection of subsamples using a random number generator. One subsample location had to be moved to the northeastern quadrant of the grid cell due to the presence of multiple identified anomalies in the southwestern quadrant. The soil collected at MI-03-SL-02 was observed to be dark brown, soft, moist, fine organic silt and medium brown, loose, wet, well-graded silty sand.

MI-03-SL-01 Sample Grid

MI-03-SL-02 Sample Grid

The sample locations are shown in Figure 5-9. Information about the samples is summarized in Table 5-8. Concentrations of all target analytes were below detection limits in all samples. Sample results are summarized in Table 5-9.

5.6.2.10 OB/OD-01

The 2008 field work to fill MC data gaps at OB/OD-01 was completed as planned.

MIS soil sample OBOD-01-SL-01 and the geotechnical sample were collected by constructing a 10-foot by 10-foot, 5- by 6-unit MIS sample grid centered on anomaly OB0083-048[6], where a grenade was found during a previous investigation. The MIS sample grid was oriented with the top of the grid facing northwest. The north quadrant of each grid cell was randomly selected for collection of the OBOD-01-SL-01 and the MIS geotechnical subsamples using a random number generator. The soil collected at OBOD-01-SL-01 was observed to be dark brown, soft, moist, fine organic silt.

MIS soil sample OBOD-01-SL-02 was collected by constructing a 10-foot by 10-foot, 5- by 6-unit MIS sample grid centered on anomaly OB13NE057[5,] where the ground was found to be saturated with CADs from a bad demo shot. The MIS sample grid was oriented with the top of the grid facing north. The northeastern quadrant of each grid cell was randomly selected for collection of the OBOD-01-SL-02 subsamples using a random number generator. The soil collected at MI-03-SL-02 was observed to be dark brown, soft, moist, fine organic silt.

MIS soil sample OBOD-01-SL-03, MIS duplicate sample OBOD-01-SL-103, and MIS triplicate sample OBOD-01-SL-203 were collected by constructing a 10-foot by 10-foot, 5- by 6-unit MIS sample grid centered on anomaly OB06SE027, where a CAD from a sonar buoy was found. The MIS sample grid was oriented with the top of the grid facing north. The southwest quadrant of each grid cell was randomly selected for collection of the OBOD-01-SL-03 subsamples using a random number generator. The soil collected at OBOD-01-SL-03 was observed to be dark brown, very soft, moist, fine organic silt.

The sample locations are shown in Figure 5-10. Information about the samples is summarized in Table 5-8. With the exception of nitroglycerin in OBOD-01-SL-02, concentrations of all target analytes were below detection limits in all samples. Nitroglycerin was detected at 0.52 mg/kg; that concentration did not exceed the conservative project screening level of 0.61 mg/kg. Therefore, no follow-up sampling was conducted. Sample results are summarized in Table 5-9.

5.6.2.11 RR-01

The 2008 field work to fill MC data gaps at RR-01 was completed as planned. Sediment sample RR-01-SD-01 was obtained by collecting subsamples from five locations where sediment was present within a mid-channel sand bar in Moffett Creek. The stream bed in this area consists of an approximately 20- to 40-foot-wide single channel. The sediments collected at RR-01 were observed to be loose, light brown, moist to saturated, well-graded fine sand.

The sample location is shown in Figure 5-11. Information about the sample is summarized in Table 5-8. Concentrations of all target analytes were below detection limits in all samples. Sample results are summarized in Table 5-10.

5.6.2.12 RR-02

The 2008 field work to fill MC data gaps at RR-02 was completed as planned MIS soil sample RR-02-SL-01 was collected by constructing a 50-foot by 50-foot, 5- by 6-unit MIS sample grid centered on the previously identified breached items location. The RR-02-SL-01 MIS sample grid was oriented with the top of the grid facing north. The northeast quadrant of each grid cell was randomly selected for collection of subsamples using a random number generator. The soil collected at RR-02-SL-01 was observed to be dark brown, soft, moist to wet, fine organic silt with significant roots.

RR-02-SL-01 Sample Grid

The sample location is shown in Figure 5-12. Information about the samples is summarized in Table 5-8.

[6] Anomaly numbers listed on Figure P in the RI Work Plan were erroneous and have been corrected to match locations and items in MEC database.

Concentrations of all target analytes were below detection limits in all samples. Sample results are summarized in Table 5-9.

5.6.2.13 RR-04

The 2008 field work to fill MC data gaps at RR-04 was completed as planned. However, some adjustments to the groundwater sample locations were necessary to facilitate access and allow for safe installation and sampling of three temporary wells.

Three temporary well locations were moved between 15 and 50 feet away from the proposed locations shown in Figure U of the RI Work Plan. The new locations fulfilled the same objectives as those proposed, in that the wells were down gradient of the ranges and arranged so that three wells were located on either side of Moffett Creek. The changes in location were documented in a FCR (FCR-10), which is included in Appendix H.

Surface water sample RR-04-SW-01 and field duplicate RR-04-SW-101 were collected near co-located sediment sample RR-04-SD-01 within the Mitchell Creek drainage channel at the mouth of Moffett Creek, west of the road paralleling Andrew Lake. Moffett Creek in this area is an approximately 30-foot-wide predominantly single-channel stream and discharges to Andrew Lake. The samples were collected within an approximately 8-inch-deep channel on the edge of the main channel. Surface water sampling was conducted prior to sediment sampling at this location. The surface water was observed to be clear, cold, and flowing rapidly.

Sediment sample RR-04-SD-01 and field duplicate RR-04-SD-101 were collected near co-located sediment sample RR-04-SW-01 within the Mitchell Creek drainage channel at the mouth of Moffett Creek, west of the road paralleling Andrew Lake. The sample was obtained from five subsample locations where sediment was present in Moffett Creek just upstream from Andrew Lake. The sediments collected at RR-04-SD-01 were observed to be very loose, light brown, saturated, poorly-graded fine sand with little or no fines.

Sediment sample RR-04-SD-02 was collected from the Moffett Creek drainage channel about midway through the AOC. RR-04-SD-02 was obtained from five subsample locations where sediment was present at a meander of Moffett Creek upstream from RR-04-SD-01. The sediment collected at RR-04-SD-02 was observed to be very loose, light brown, saturated, well-graded fine sand with some organics.

Six temporary, shallow groundwater sampling points were installed near the Andrew Lake shoreline, west of the road paralleling Andrew Lake: three north of Moffett Creek and three south of Moffett Creek. Groundwater samples RR-04-GW-01 through RR-04-GW-06, and a field duplicate, were collected from the six installed wells. RR-04-GW-04, RR-04-GW-05, and RR-04-GW-06 were collected approximately 43 feet west-northwest, 57 feet south, and 15 feet east of their proposed sample locations, respectively. The groundwater within RR-04 was observed to be cold with medium to low turbidity and no observable odor.

The sample locations are shown in Figure 5-13. Information about each sample is summarized in Table 5-8. Concentrations of all target analytes were below detection limits in all samples. Sample results are summarized in Tables 5-10, 5-11, and 5-12.

5.6.2.14 SA-01

No sampling was proposed at SA-01 in the 2008 RI Work Plan.

5.6.2.15 SA93-01

The 2008 field work to fill MC data gaps at SA93-01 was completed as planned. MIS soil sample SA93-01-SL-01 was collected by constructing a 50-foot by 50-foot, 5- by 6-unit MIS sample grid centered on the previously identified breached items location at anomaly 9321010. The SA93-01-SL-01 MIS sample grid was oriented with the top of the grid facing northeast. The western quadrant of each grid cell was randomly selected for collection of subsamples using a random number generator. The soil collected at SA93-01-SL-01 was observed to be dark gray and brown, soft, moist, fine organic silt. In some subsample locations, a light brown-yellowish silt layer was observed approximately 2 to 3 inches below the vegetative-mineral soil interface.

SA93-01-SD-01 and SW-01 Sample Location

MIS soil sample SA93-01-SL-02 was collected by constructing a 50-foot by 50-foot, 5- by 6-unit MIS sample grid centered on the previously identified breached items location at anomaly 9317002. The SA93-01-SL-02 MIS soil sample grid was oriented with the top of the grid facing north. The southwestern quadrant of each grid cell was randomly selected for collection of subsamples using a random number generator. One subsample location had to be moved to the northeastern quadrant of the grid cell due to the presence of multiple identified anomalies in the southwestern quadrant. The soil collected at SA93-01-SL-02 was observed to be a dark gray and brown, soft, moist, fine organic silt.

Surface water sample SA93-01-SW-01 was collected just south of the junction of the two drainage channels shown in Figure 5-16. Surface water sampling was conducted prior to sediment sampling at this location. The sample was collected directly into sample jars. The surface water was observed to be cold with low turbidity, and flowing moderately rapidly.

Sediment sample SA93-01-SD-01 was obtained from five subsample locations where sediment was present in the creek bed just south of the junction of the two drainage channels shown in Figure 5-16. Sediments collected at SA93-01-SD-01 were observed to be very loose, light brown, saturated, poorly-graded fine sand with little or no fines.

The sample locations are shown in Figure 5-15. Information about each sample is summarized in Table 5-8. Concentrations of all target analytes in all samples were below detection limits. Sample results are summarized in Tables 5-9, 5-10, and 5-12.

SA93-01-SL-01 Sample Grid

SA93-01-SL-02 Sample Grid and Location Clearance Using Whites XLT

5.6.2.16 SA93-02

The 2008 field work to fill MC data gaps at SA93-02 was completed as planned.

Surface water sample SA93-02-SW-01 was collected within the Mitchell Creek drainage channel at the southern end of the AOC. Surface water sampling was conducted prior to sediment sampling at this location. The surface water sample volumes were collected directly into sample jars. The surface water was observed to be cold, of low turbidity, and flowing moderately rapidly.

Sediment sample SA93-02-SD-01 was collected from five subsample locations where sediment was present in the creek bed at the southern end of the AOC. The sediment collected at SA93-01-SD-01 was very loose, light brown, saturated, poorly-graded fine sand with little or no fines.

The sample location is shown in Figure 5-16. Information about each sample is summarized in Table 5-8. Concentrations of all target analytes in all samples were below detection limits. Sample results are summarized in Tables 5-10 and 5-12.

5.6.2.17 SA93-03

The 2008 field work to fill MC data gaps at SA93-03 was completed as planned.

MIS soil sample SA93-03-SL-01 was collected by constructing a 10-foot by 10-foot, 5- by 6-unit MIS sample grid centered on the previously identified breached items location at anomaly 9304004. The SA93-03-SL-01 MIS sample grid was oriented with the top of the grid facing north. The southeast quadrant of each grid cell was randomly selected for collection of subsamples using a random number generator. The soil collected at SA93-03-SL-01 was observed to be dark brown, soft, moist, fine organic silt.

The sample location is shown in Figure 5-18. Information about the sample is summarized in Table 5-8. Concentrations of all target analytes in all samples were below detection limits. Sample results are summarized in Table 5-9.

5.6.2.18 SA93-04

No breached items were found during the intrusive investigations at SA93-04; thus no MIS soil samples were collected and no analytical results were reported.

5.7 RG-01 Rifle Grenade Range MC Sample Information

Breached munitions were found at target #CS41-146 and target #CU41-313, in RG-01 during UXO clearance activities in 2008. In accordance with the MC QAPP for the clearance activities at LJ-01 and RG-01 (USAE, 2008c), MIS soil samples were collected at the breached munitions locations; follow-up sampling was conducted at one of the locations because the concentration of RDX exceeded the LJ-01/RG-01 project screening level. Although technically not part of the remedial investigation for OU B-2, the sampling program for the RG-01 samples is described here because the analytical results for the samples were considered in the overall chemical risk screening effort for OU B-2 (see Section 8). The sample locations are shown in Figure 5-19. Information about each sample is summarized in Table 5-24 and described below.

TABLE 5-24
2008 RG-01 Sampling Information

Sample ID	Depth	Medium	Sample Type	Sample Date	QA/QC
RG-01-SL-01	0 – 3 inches	Soil	MIS (10- x 10-foot grid)	9/9/2008	
RG-01-SL-02	0 – 3 inches	Soil	MIS (10- x 10-foot grid)	9/9/2008	
RG-01-SL-102	0 – 3 inches	Soil	MIS (10- x 10-foot grid)	9/9/2008	Duplicate of RG-01-SL-02

TABLE 5-24
2008 RG-01 Sampling Information

Sample ID	Depth	Medium	Sample Type	Sample Date	QA/QC
RG-01-SL-202	0 – 3 inches	Soil	MIS (10- x 10-foot grid)	9/9/2008	Triplicate of RG-01-SL-02
RG-01-SL-01A	0 – 3 inches	Soil	Discrete	10/7/08	
RG-01-SL-01B	0 – 3 inches	Soil	Discrete	10/7/08	
RG-01-SL-01C	0 – 3 inches	Soil	Discrete	10/7/08	
RG-01-SL-01D	0 – 3 inches	Soil	Discrete	10/7/08	
RG-01-SL-01E	0 – 3 inches	Soil	Discrete	10/7/08	
RG-01-SL-01F	0 – 3 inches	Soil	Discrete	10/7/08	
RG-01-SL-01G	0 – 3 inches	Soil	Discrete	10/7/08	
RG-01-SL01H	0 – 3 inches	Soil	Discrete	10/7/08	
RG-01-SL-01I	0 – 3 inches	Soil	Discrete	10/7/08	
RG-01-SL-01J	0 – 3 inches	Soil	Discrete	10/7/08	Field duplicate of RG-01-SL-01A

Soil samples RG-01-SL-01 and RG-01-SL-02 were collected by constructing 10-foot by 10-foot, 5- by 6-unit MIS sample grids centered on the former location of the breached items, as follows:

- The RG-01-SL-01 MIS sample grid was oriented with the top of the grid facing north. The southeastern quadrant of each grid cell was randomly selected for collection of subsamples using a random number generator. The soil collected at RG-01-SL-01 was observed to be dark gray and brown, soft, moist, fine organic silt.
- The RG-01-SL-02 MIS soil sample grid was oriented with the top of the grid facing north. The southwestern quadrant of each grid cell was randomly selected for collection of subsamples using a random number generator. Duplicate and triplicate samples (RG-01-SL-102 and RG-01-SL-202) were taken from the southeastern and northwestern quadrants of the cells. The soil collected at SA93-01-SL-02 was observed to be a dark gray and brown, soft, moist, fine organic silt.

The concentration of RDX in one MIS soil sample exceeded the screening level established in the MC QAPP for LJ-01 and RG-01. The MC QAPPs for OU B-2 and for RG-01 did not specify procedures for evaluating risk or conducting follow-up sampling in the event of an screening level exceedance. Due to limited time remaining in the field season, concerns about the RDX exceedance affecting the completeness of the NTCRA, and the need to evaluate RDX in a chemical risk assessment, the contractor conducted follow up sampling based on knowledge of ADEC risk assessment guidelines. An FCR (FCR-12) that detailed the design and sampling procedures was developed, sampling personnel were re-mobilized, and the additional sampling was performed during the week of October 6 -12, 2008.

The sampling design consisted of 10 (i.e., 9 normal and 1 field duplicate) discrete soil samples obtained from the 10-foot by 10-foot MIS sample grid for RG-01-SL-01. The follow-up samples were analyzed for RDX using EPA Method 8330B.

Sample results are summarized in Table 5-25. RDX was detected at concentrations below the screening levels in 3 samples and was not detected in the remaining 6 samples. Sampling records, field notes, photographs, other relevant sample documentation, and laboratory reports are provided in the After Action Report prepared for RG-01 (USAE, 2009).

TABLE 5-25

Analytical Results for Soil Samples Collected at RG-01

Multi-incremental Soil Samples

Sample ID				RG-01-SL-01	RG-01-SL-02	RG-01-SL-102	RG-01-SL-202
Location ID				RG-01	RG-01	RG-01	RG-01
Sample Type				MIS	MIS	MIS	MIS
QA/QC Type				N	N	FD RG-01(SL-02)	FD RG-01(SL-02)
Sample Date				09/09/08	09/09/08	09/09/08	09/09/08
Method	**Analyte**	**Units**	**PSL**				
8330B	1,3,5-Trinitrobenzene	mg/kg	180	0.079 U	0.079 U	0.079 U	0.079 U
8330B	1,3-Dinitrobenzene	mg/kg	0.58	0.063 U	0.063 U	0.063 UJ	0.063 U
8330B	2,4,6-Trinitrotoluene	mg/kg	3.6	0.083 U	0.083 U	0.083 U	0.083 U
8330B	2,4-Dinitrotoluene	mg/kg	0.72	0.083 U	0.083 U	0.083 U	0.083 U
8330B	2,6-Dinitrotoluene	mg/kg	0.73	0.083 U	0.083 U	0.083 U	0.083 U
8330B	2-Amino-4,6-Dinitrotoluene	mg/kg	0.083	0.083 U	0.083 U	0.083 U	0.083 U
8330B	2-Nitrotoluene	mg/kg	2.1	0.066 UJ	0.066 UJ	0.066 UJ	0.066 UJ
8330B	3,5-DNA	mg/kg	-	0.08 U	0.08 U	0.08 U	0.08 U
8330B	3-Nitrotoluene	mg/kg	120	0.071 UJ	0.071 UJ	0.071 UJ	0.071 UJ
8330B	4-Amino-2,6-Dinitrotoluene	mg/kg	0.075	0.075 U	0.075 U	0.075 U	0.075 U
8330B	4-Nitrotoluene	mg/kg	29	0.095 UJ	0.095 UJ	0.095 UJ	0.095 UJ
8330B	HMX	mg/kg	60	**1.3**	0.08 U	0.08 U	0.08 U
8330B	Nitrobenzene	mg/kg	2	0.075 UJ	0.075 UJ	0.075 UJ	0.075 UJ
8330B	Nitroglycerin	mg/kg	0.61	0.085 U	0.085 U	0.085 U	0.085 U
8330B	PETN	mg/kg	-	0.579 UJ	0.579 UJ	0.579 UJ	0.579 UJ
8330B	RDX	mg/kg	4.4	**6.7**	0.08 U	0.08 UJ	0.08 U
8330B	Tetryl	mg/kg	24	0.091 U	0.091 U	0.091 U	0.091 U

Discrete Samples (RG-01-SL-01 Decision Area)

Sample ID				RG-01-SL-01A	RG-01-SL-01J	RG-01-SL-01B	RG-01-SL-01C	RG-01-SL-01D	RG-01-SL-01E	RG-01-SL-01F	RG-01-SL-01G	RG-01-SL-01H	RG-01-SL-01I
Location ID				RG-01	RG-01	RG-01	RG-01	RG-01	RG-01	RG-01	RG-01	RG-01	RG-01
Sample Type				Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete
QA/QC Type				N	FD (RG-01-SL-01A)	N	N	N	N	N	N	N	N
Sample Date				10/7/2008	10/7/2008	10/7/2008	10/7/2008	10/7/2008	10/7/2008	10/7/2008	10/7/2008	10/7/2008	10/7/2008
Method	**Analyte**	**Units**	**PSL**										
8330B	1,3,5-Trinitrobenzene	mg/kg	180	--	--	--	--	--	--	--	--	--	--
8330B	1,3-Dinitrobenzene	mg/kg	0.58	--	--	--	--	--	--	--	--	--	--
8330B	2,4,6-Trinitrotoluene	mg/kg	3.6	--	--	--	--	--	--	--	--	--	--
8330B	2,4-Dinitrotoluene	mg/kg	0.72	--	--	--	--	--	--	--	--	--	--
8330B	2,6-Dinitrotoluene	mg/kg	0.73	--	--	--	--	--	--	--	--	--	--
8330B	2-Amino-4,6-Dinitrotoluene	mg/kg	0.083	--	--	--	--	--	--	--	--	--	--
8330B	2-Nitrotoluene	mg/kg	2.1	--	--	--	--	--	--	--	--	--	--
8330B	3,5-DNA	mg/kg	-	--	--	--	--	--	--	--	--	--	--
8330B	3-Nitrotoluene	mg/kg	120	--	--	--	--	--	--	--	--	--	--
8330B	4-Amino-2,6-Dinitrotoluene	mg/kg	0.075	--	--	--	--	--	--	--	--	--	--
8330B	4-Nitrotoluene	mg/kg	29	--	--	--	--	--	--	--	--	--	--
8330B	HMX	mg/kg	60	--	--	--	--	--	--	--	--	--	--
8330B	Nitrobenzene	mg/kg	2	--	--	--	--	--	--	--	--	--	--
8330B	Nitroglycerin	mg/kg	0.61	--	--	--	--	--	--	--	--	--	--
8330B	PETN	mg/kg	-	--	--	--	--	--	--	--	--	--	--
8330B	RDX	mg/kg	4.4	**0.46** J	0.08 U	**0.2** J	0.08 U	0.08 U	**0.42** J	0.08 U	0.08 U	0.08 U	0.08 U
8330B	Tetryl	mg/kg	24	--	--	--	--	--	--	--	--	--	--

Bold font indicates detected value

Yellow highlighting indicates detected value in excess of PSL

MIS = multi-incremental soil sample, a single composited soil sample made up of 30 discrete sub-samples obtained within a specified decision area

NL = not listed

-- = not analyzed

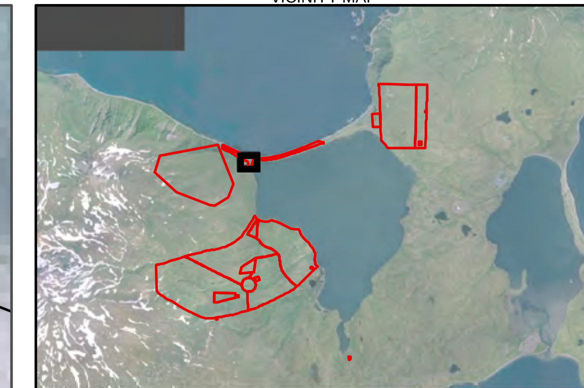
Qualifiers

J = The analyte was positively identified; but the associated numerical value is the approximate concentration of the analyte in the sample.

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ = Estimated non-detect - The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate.

VICINITY MAP



MEC Investigation
- 2008 Unexploded Ordnance (UXO)
- ALSW-01 West Recon Transect
- Grid
- Instrument Aided Visual Reconnaissance
- Accessibility Survey Area, Slopes Greater Than 30 Degrees

MC Investigation
- 2008 Soil Sample

Topography and Site Features
- Subject AOC
- AOC
- Slopes Greater Than 30 Degrees (As calculated from terrain model)
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

Notes:
Aerial photography: 2000 fly-over (AEROMAP)

0 65 130
Feet

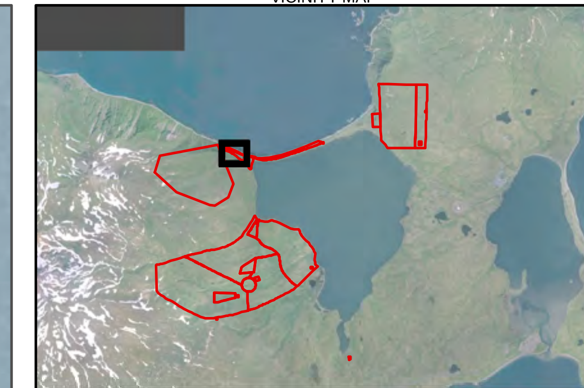
N

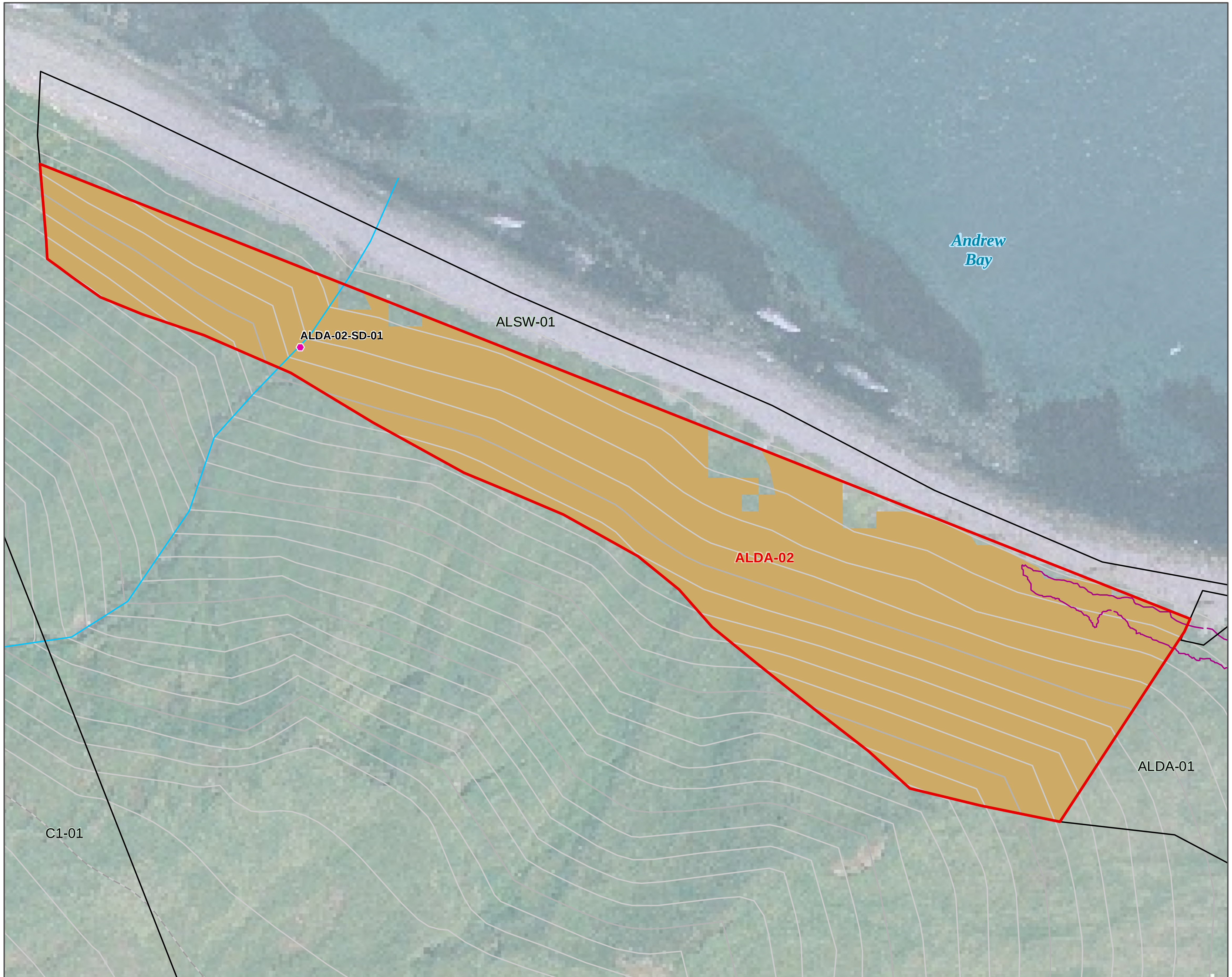
FIGURE 5-1
ALDA-01 2008 Investigation Results and Sample Locations
OU B-2 Remedial Investigation Report
Adak Island, Alaska

SEA \\JAFAR\PROJ\ADAK_335753\MAPFILES\RIFS_2011\INVESTIGATION2008_MAPBOOK.MXD RGRABARE 4/11/12 2:41:20 PM

CH2MHILL

VICINITY MAP





MEC Investigation

ALSW-01 West Recon Transect

MC Investigation

2008 Sediment Sample

Topography and Site Features

Subject AOC

AOC

Slopes Greater Than 30 Degrees (As calculated from terrain model)

500-ft Contour

100-ft Contour

20-ft Contour

Road

Stream

Standing Water

Notes:
Aerial photography: 2000 fly-over (AEROMAP)

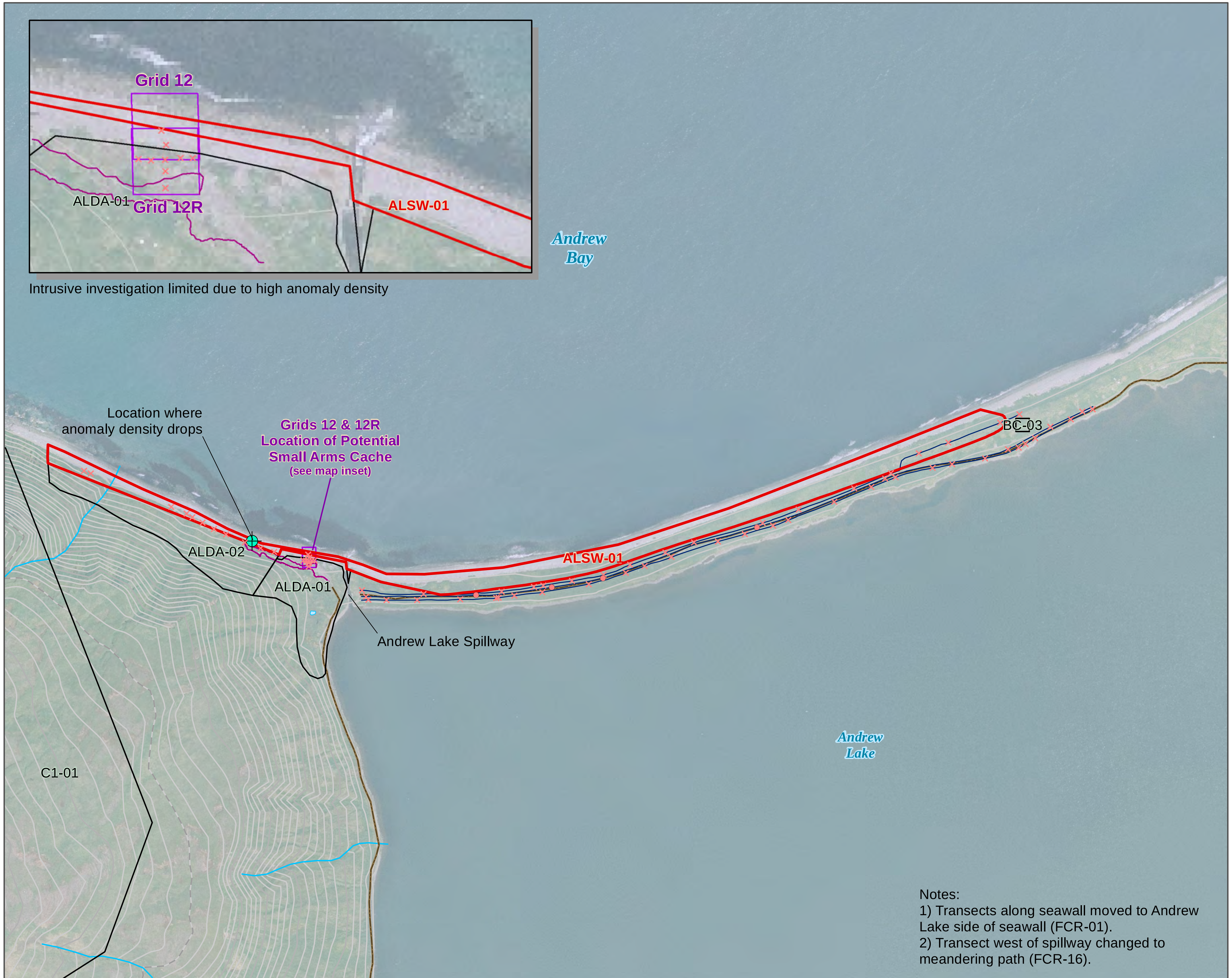
0 100 200
Feet

N

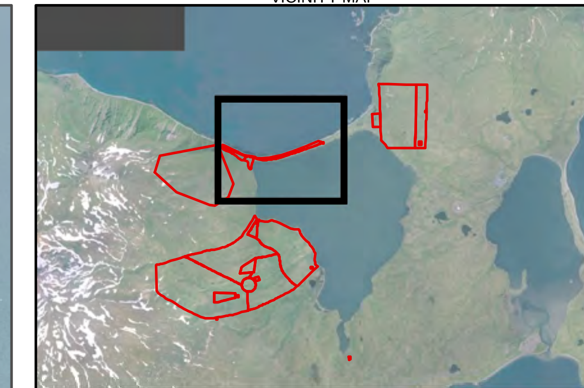
FIGURE 5-2
ALDA-02 2008 Sample Locations
OU B-2 Remedial Investigation Report
Adak Island, Alaska

CH2MHILL

SEA \\JAFAR\PROJ\ADAK_335753\MAPFILES\RIFS_2011\INVESTIGATION2008_MAPBOOK.MXD RGRABARE 4/11/12 2:41:20 PM



VICINITY MAP



MEC Investigation

- 2008 Munitions Debris (MD)
- 2008 Other (not munitions-related material)
- ALSW-01 West Recon Transect
- Grid

Topography and Site Features

- Subject AOC
- AOC
- Slopes Greater Than 30 Degrees (As calculated from terrain model)
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

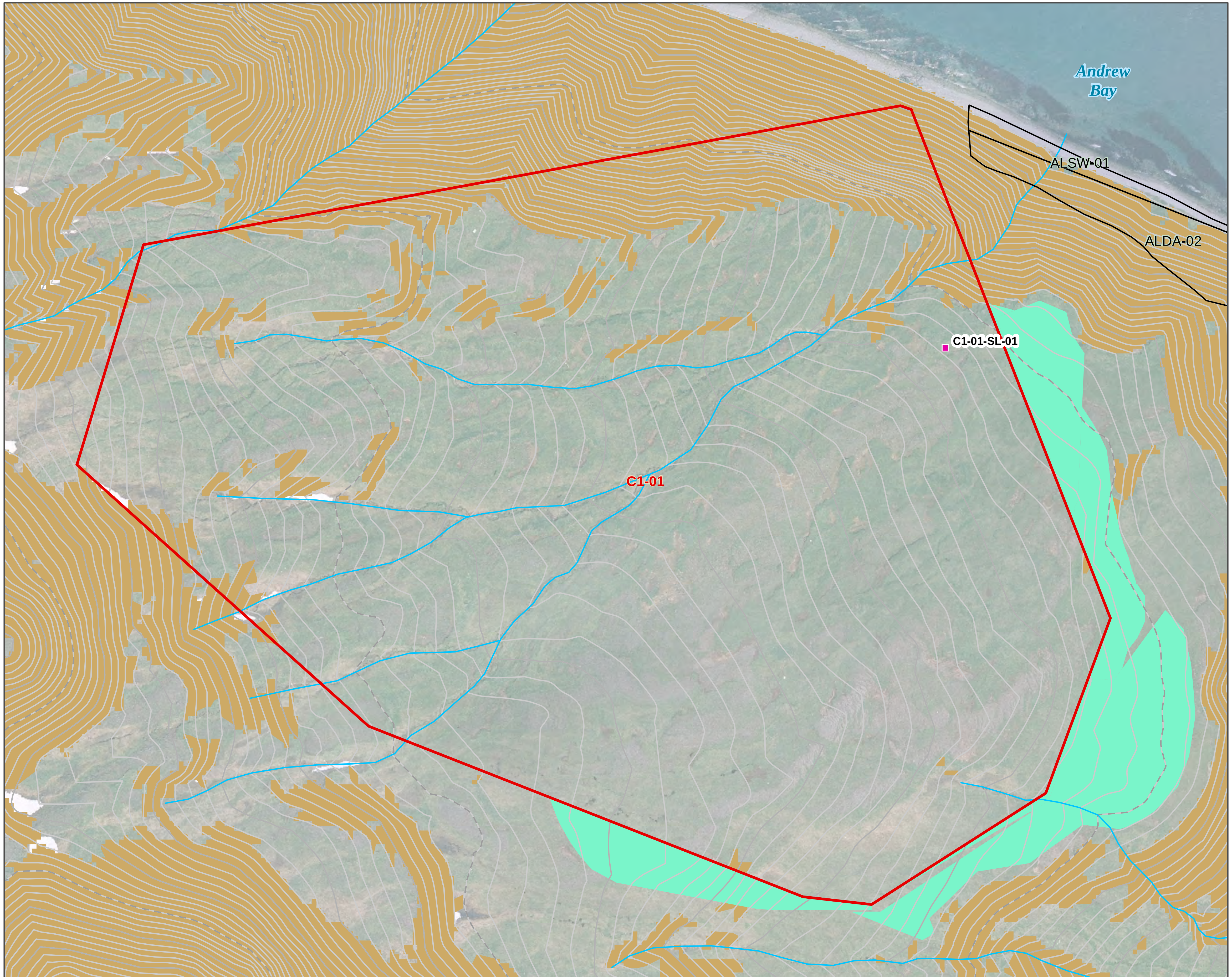
Notes:
Aerial photography: 2000 fly-over (AEROMAP)

0 500 1,000
Feet

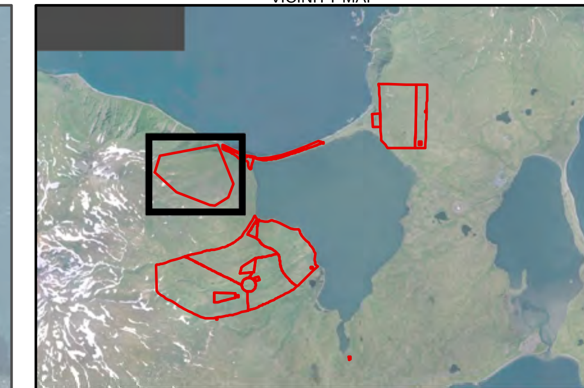
N

FIGURE 5-3
ALSW-01 2008 Investigation Results
OU B-2 Remedial Investigation Report
Adak Island, Alaska

CH2MHILL



VICINITY MAP



MEC Investigation

Accessibility Survey Area, Slopes Greater Than 30 Degrees

MC Investigation

2008 Soil Sample

Topography and Site Features

Subject AOC

AOC

Slopes Greater Than 30 Degrees (As calculated from terrain model)

500-ft Contour

100-ft Contour

20-ft Contour

Road

Stream

Standing Water

Notes:
Aerial photography: 2000 fly-over (AEROMAP)

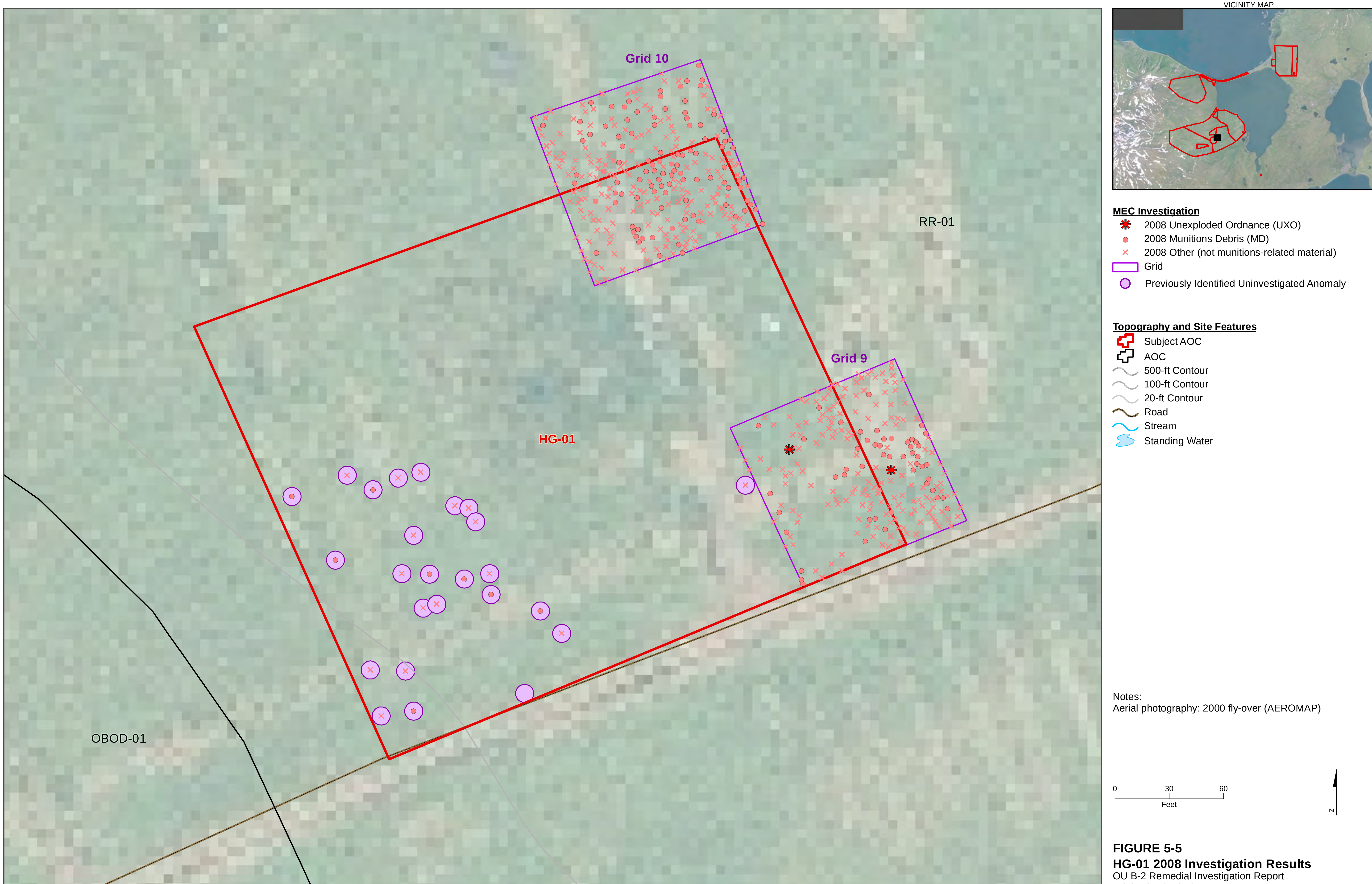
0 370 740
Feet

N

FIGURE 5-4
C1-01 2008 Sample Locations
OU B-2 Remedial Investigation Report
Adak Island, Alaska

SEA \\JAFAR\PROJ\ADAK_335753\MAPFILES\RIFS_2011\INVESTIGATION2008_MAPBOOK.MXD RGRABARE 4/11/12 2:41:20 PM

CH2MHILL

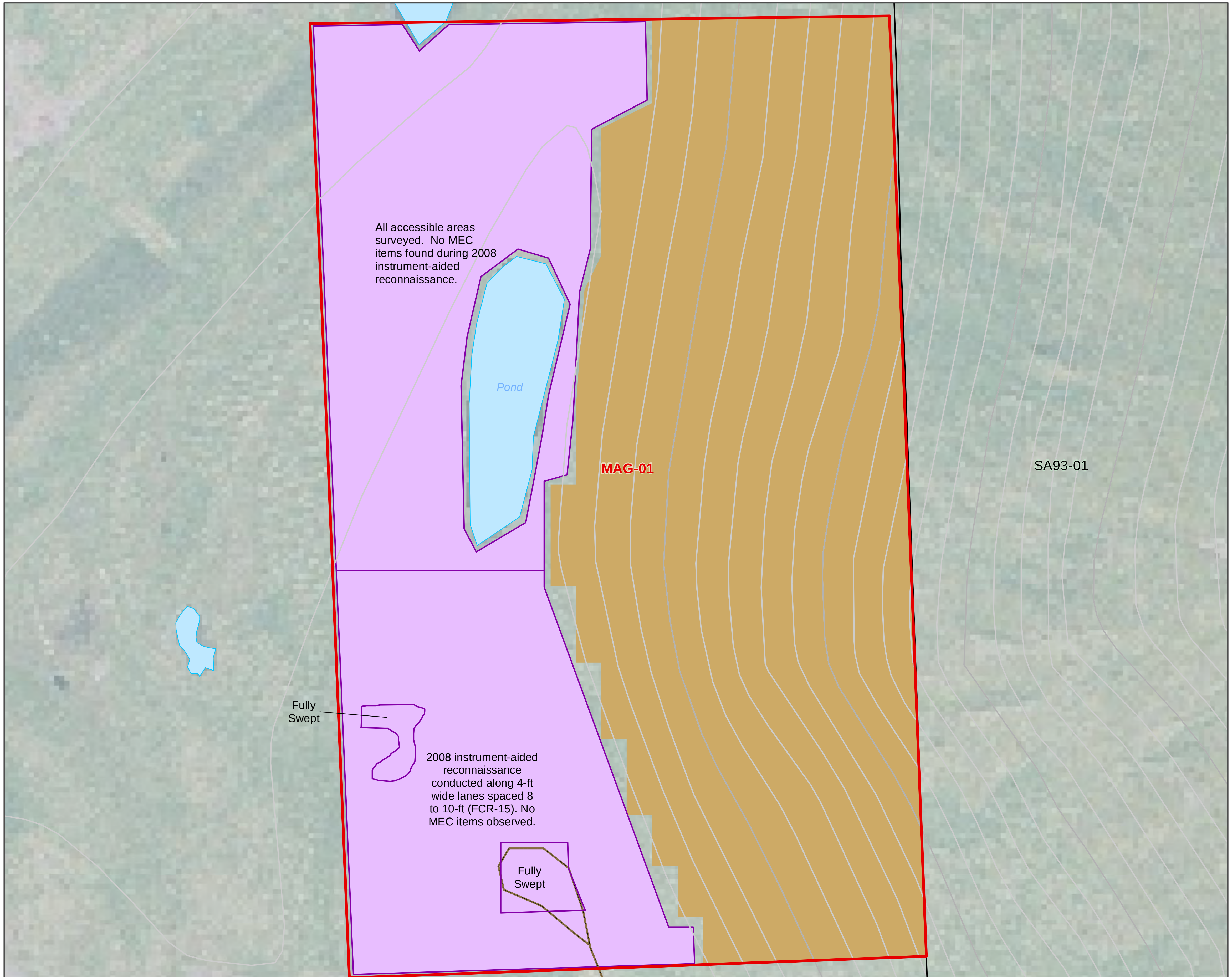


Notes:
Aerial photography: 2000 fly-over (AEROMAP)

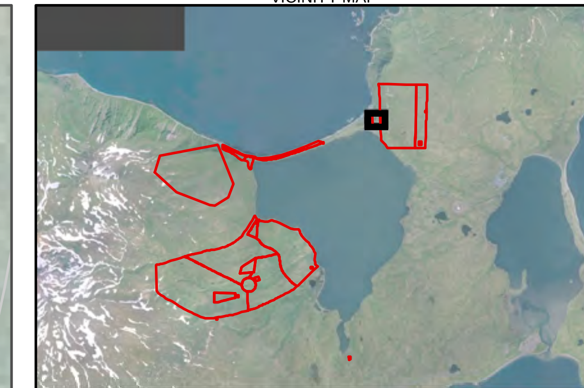
FIGURE 5-5
HG-01 2008 Investigation Results
OU B-2 Remedial Investigation Report
Adak Island, Alaska

CH2MHILL

SEA \\JAFAR\PROJ\ADAK_335753\MAPFILES\RIFS_2011\INVESTIGATION2008_MAPBOOK.MXD RGRABARE 4/11/12 2:41:20 PM



VICINITY MAP



MEC Investigation

- Instrument Aided Visual Reconnaissance

Topography and Site Features

- Subject AOC
- AOC
- Slopes Greater Than 30 Degrees (As calculated from terrain model)
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

Notes:
Aerial photography: 2000 fly-over (AEROMAP)

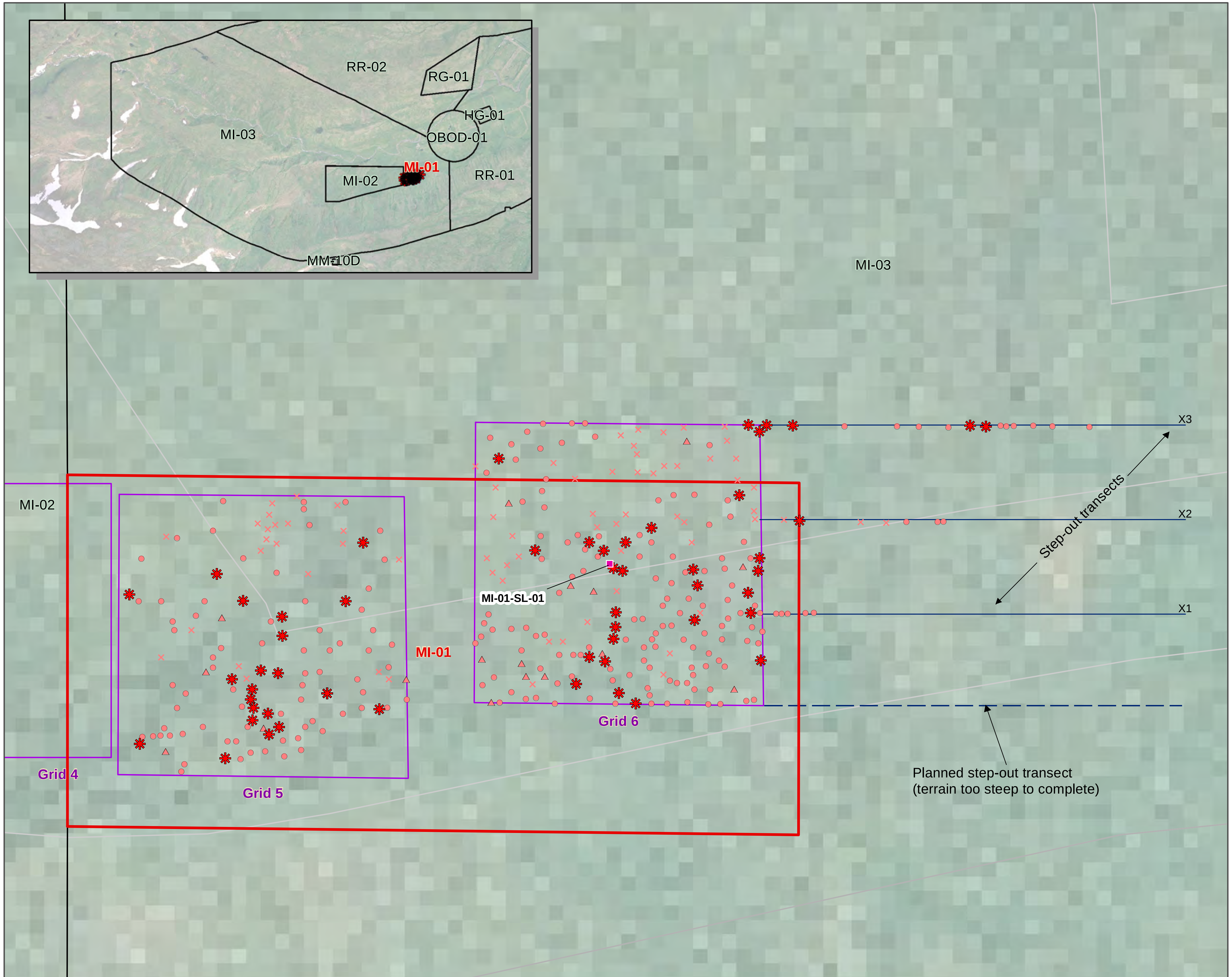
0 65 130
Feet

N

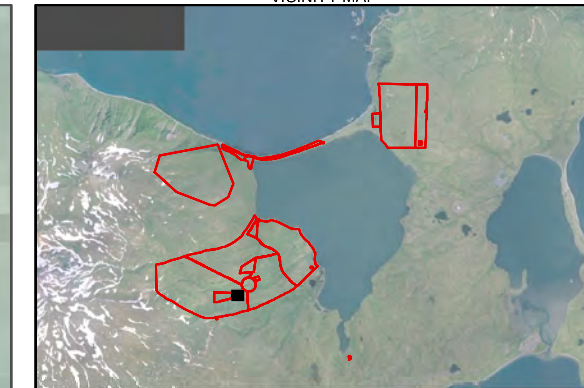
FIGURE 5-6
MAG-01 2008 Investigation Results
OU B-2 Remedial Investigation Report
Adak Island, Alaska

CH2MHILL

SEA \\JAFAR\PROJ\ADAK_335753\MAPFILES\RIFS_2011\INVESTIGATION2008_MAPBOOK.MXD RGRABARE 4/11/12 2:41:20 PM



VICINITY MAP



MEC Investigation
- 2008 Unexploded Ordnance (UXO)
- 2008 Material Presenting Potential Explosive Hazard (MPPEH)
- 2008 Munitions Debris (MD)
- 2008 Other (not munitions-related material)
- 2008 Geophysical Survey Transect
- Grid
- Instrument Aided Visual Reconnaissance

MC Investigation
- 2008 Soil Sample

Topography and Site Features
- Subject AOC
- AOC
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

Notes:
Aerial photography: 2000 fly-over (AEROMAP)

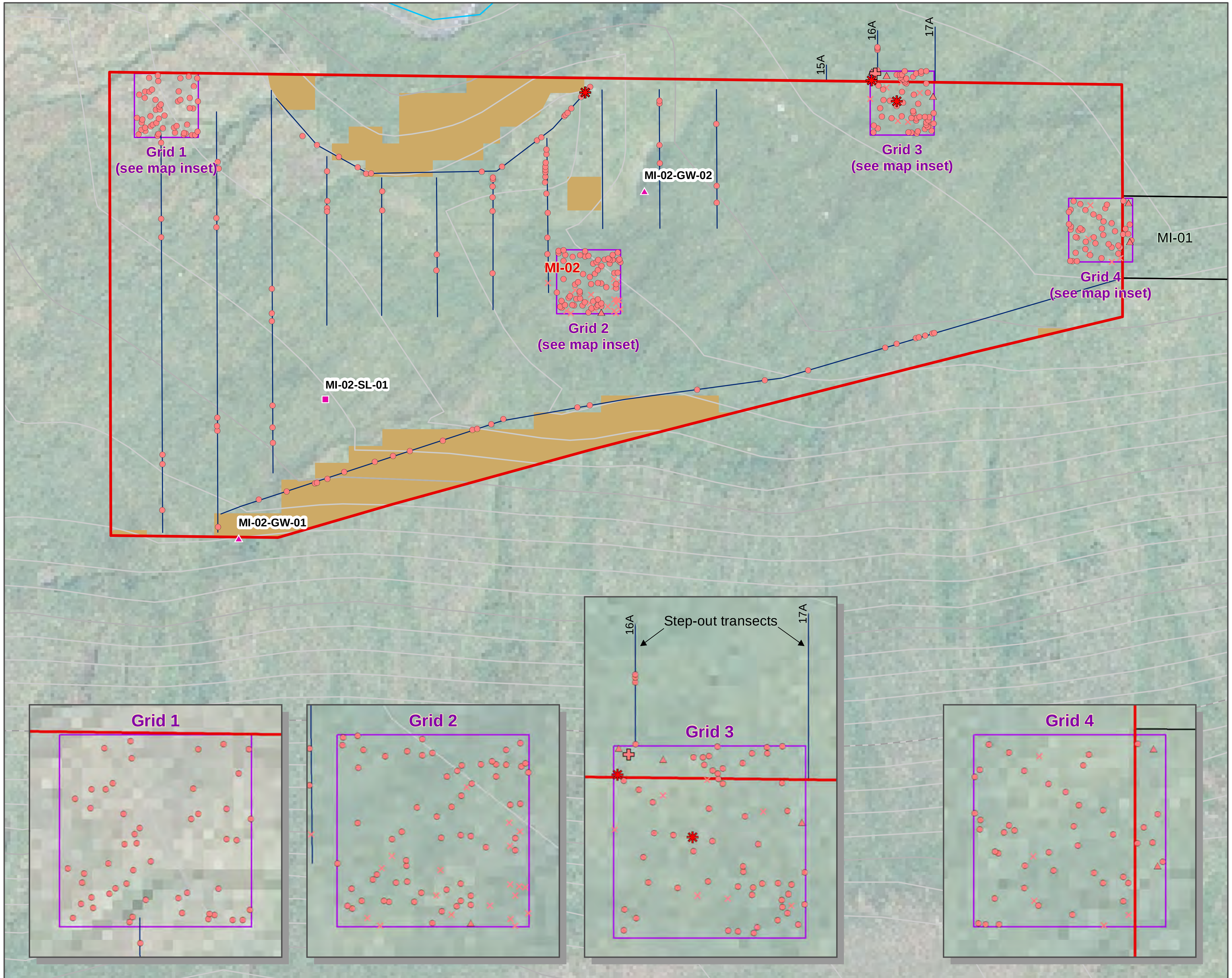
0 20 40
Feet

N

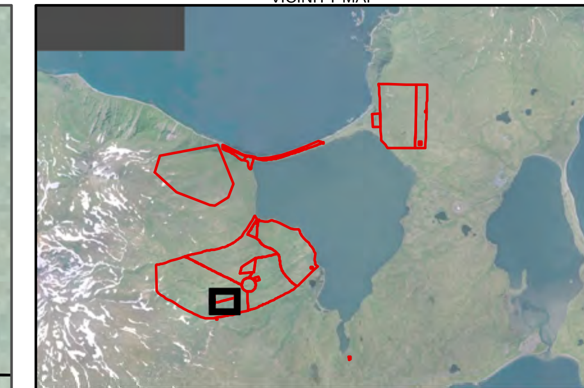
FIGURE 5-7
MI-01 2008 Investigation Results and Sample Locations
OU B-2 Remedial Investigation Report
Adak Island, Alaska

CH2MHILL

SEA \\JAFAR\PROJ\ADAK_335753\MAPFILES\RIFS_2011\INVESTIGATION2008_MAPBOOK.MXD RGRABARE 4/11/12 2:41:20 PM



VICINITY MAP



MEC Investigation
- 2008 Unexploded Ordnance (UXO)
- 2008 Discarded Military Munitions (DMM)
- 2008 Material Presenting Potential Explosive Hazard (MPPEH)
- 2008 Munitions Debris (MD)
- 2008 Other (not munitions-related material)
- 2008 Geophysical Survey Transect
- Grid

MC Investigation
- 2008 Groundwater Sample
- 2008 Soil Sample

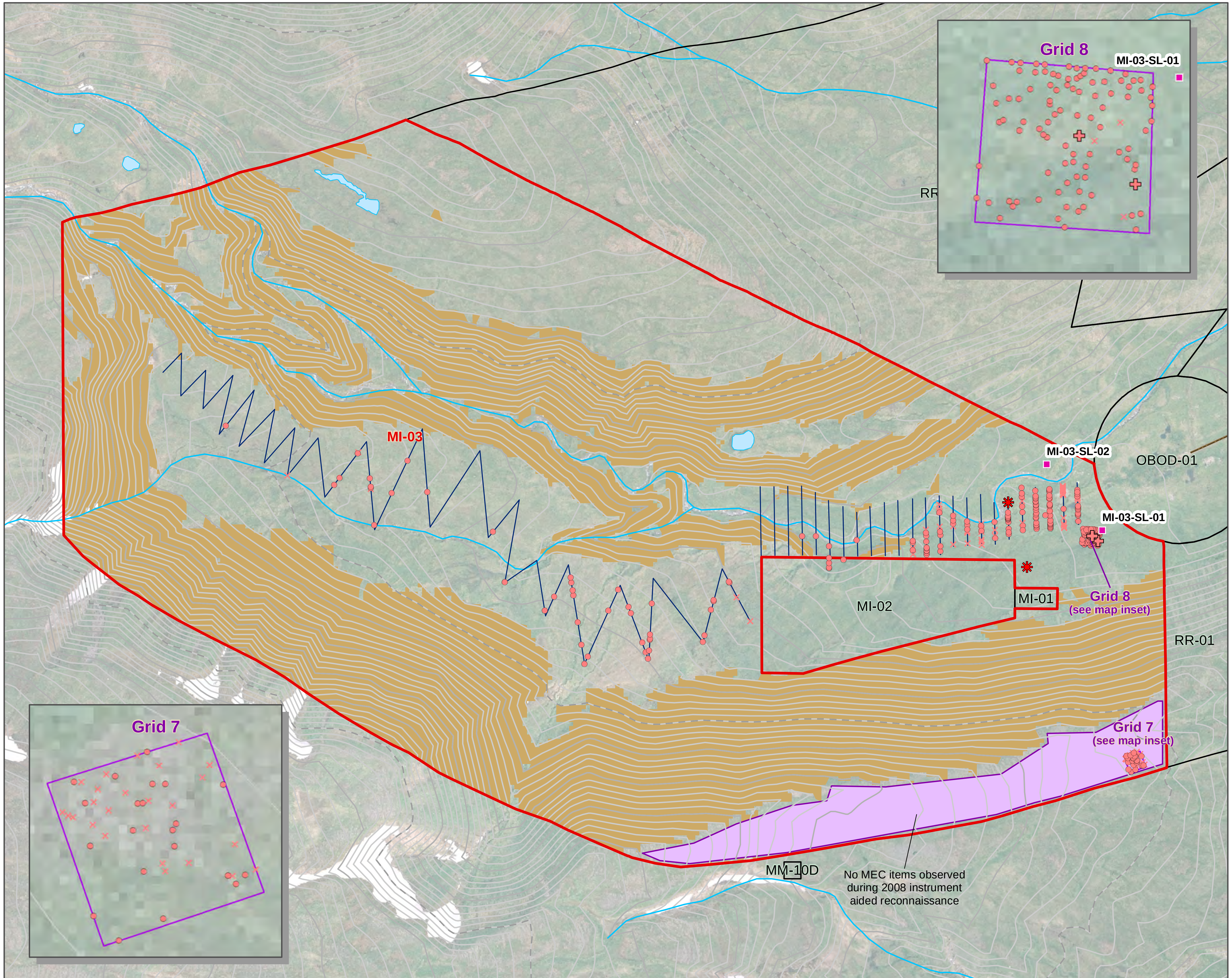
Topography and Site Features
- Subject AOC
- AOC
- Slopes Greater Than 30 Degrees (As calculated from terrain model)
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

Notes:
Aerial photography: 2000 fly-over (AEROMAP)

0 100 200
Feet

N

FIGURE 5-8
MI-02 2008 Investigation Results and Sample Locations
OU B-2 Remedial Investigation Report
Adak Island, Alaska



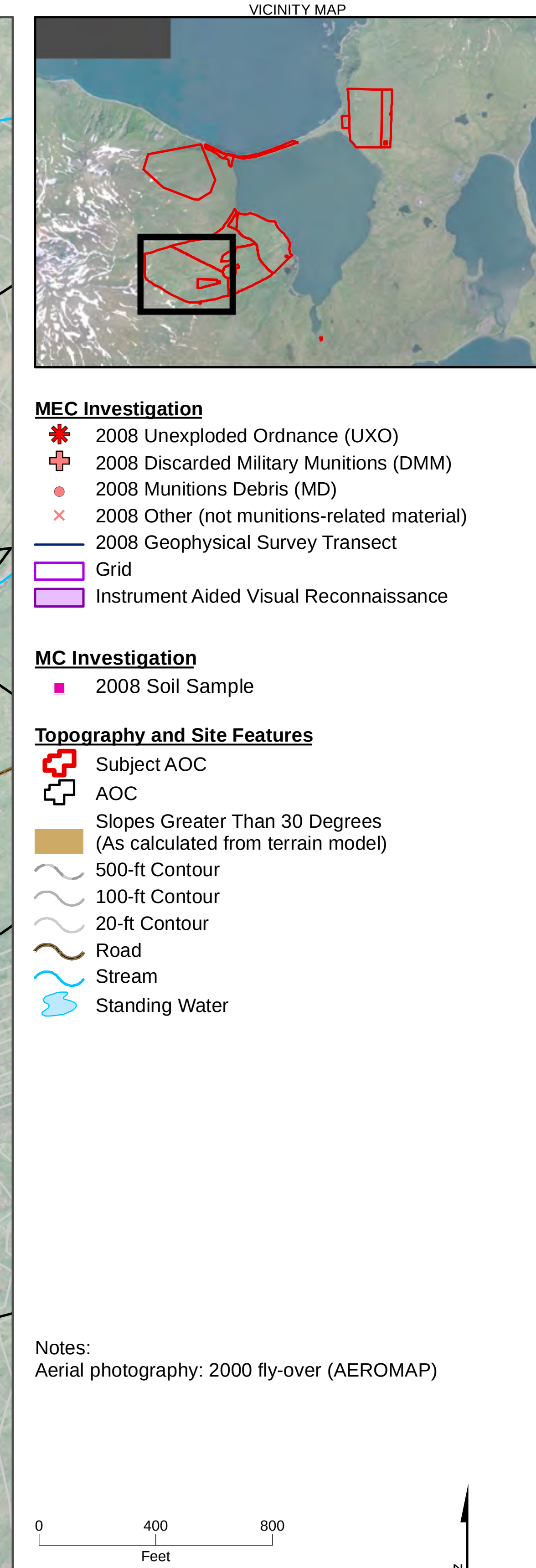
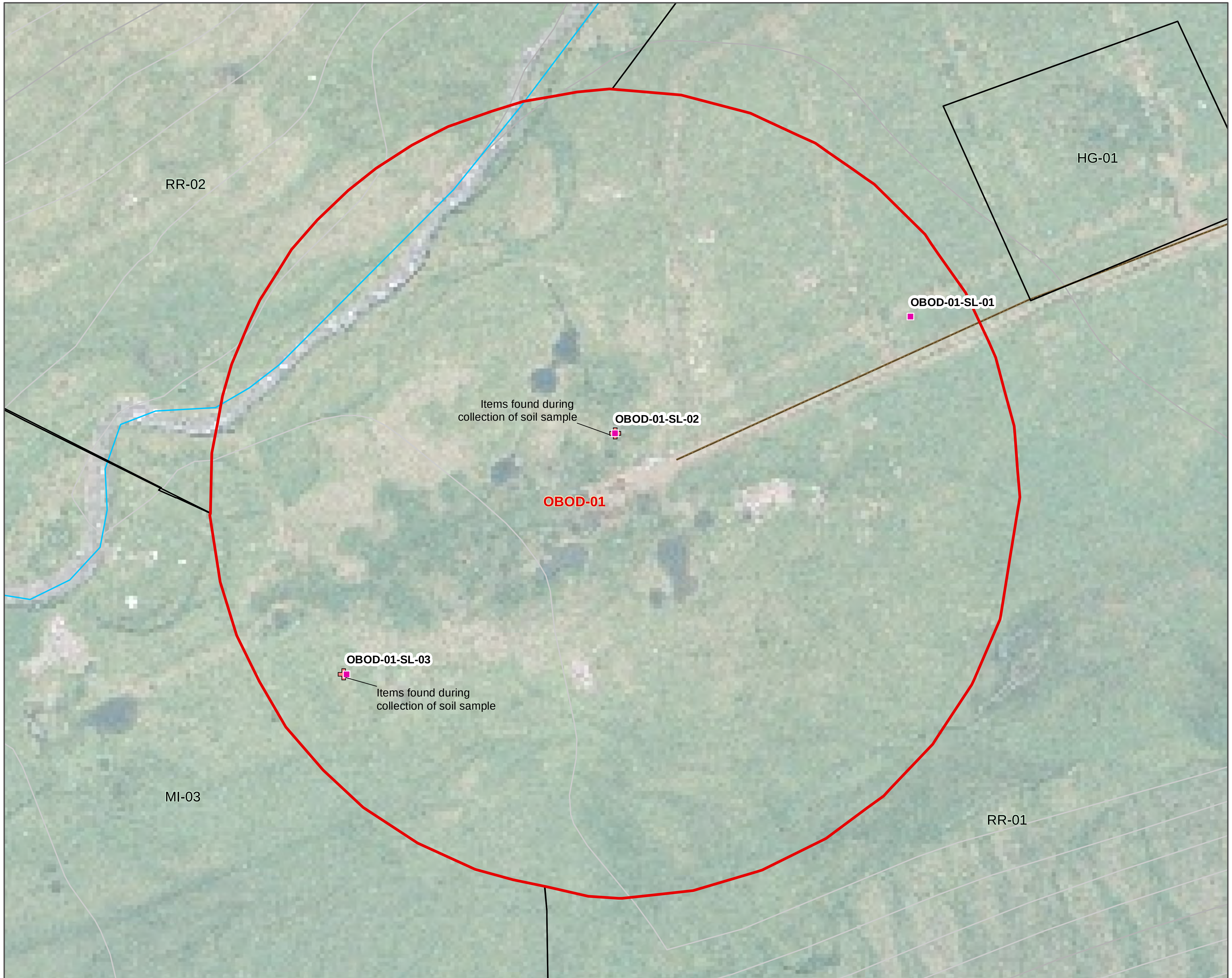
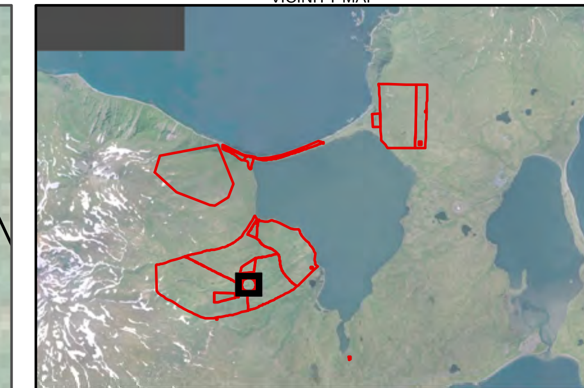


FIGURE 5-9
MI-03 2008 Investigation Results and Sample Locations
OU B-2 Remedial Investigation Report
Adak Island, Alaska

CH2MHILL



VICINITY MAP



MEC Investigation
- 2008 Discarded Military Munitions (DMM)

MC Investigation
- 2008 Soil Sample

Topography and Site Features
- Subject AOC
- AOC
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

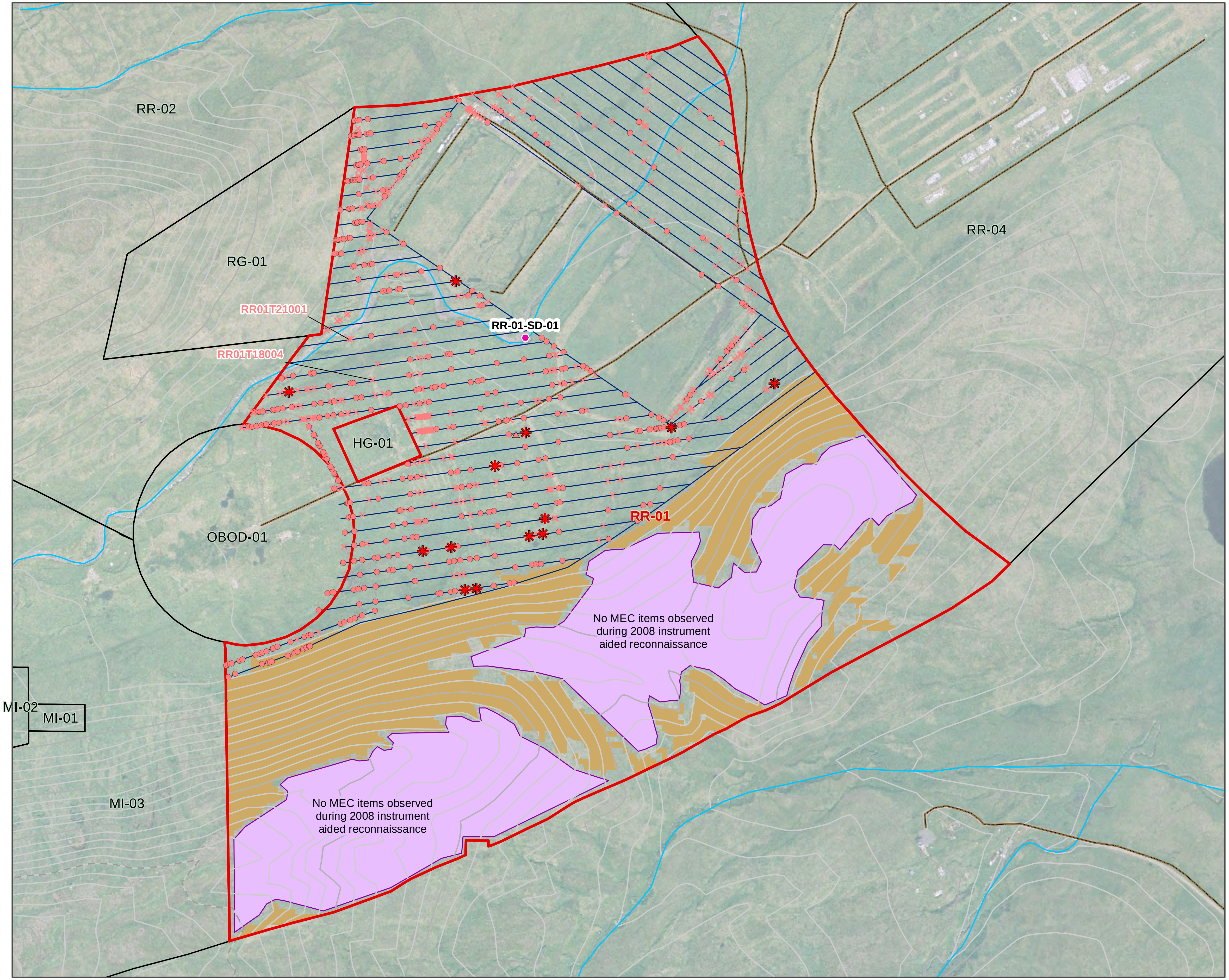
Notes:
Aerial photography: 2000 fly-over (AEROMAP)

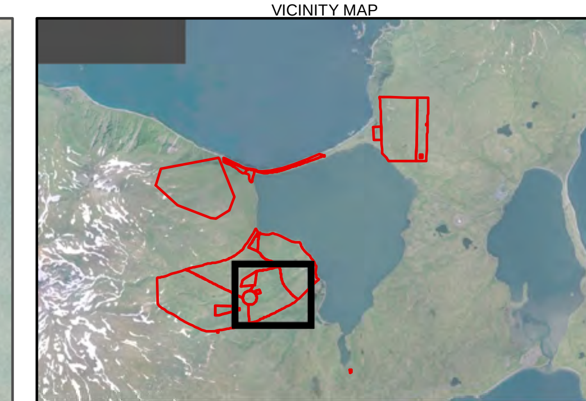
0 80 160
Feet

N

FIGURE 5-10
OB/OD-01 2008 Sample Locations
OU B-2 Remedial Investigation Report
Adak Island, Alaska

CH2MHILL





MEC Investigation
- 2008 Unexploded Ordnance (UXO)
- 2008 Material Presenting Potential Explosive Hazard (MPPEH)
- 2008 Munitions Debris (MD)
- 2008 Other (not munitions-related material)
- 2008 Geophysical Survey Transect
- Instrument Aided Visual Reconnaissance

MC Investigation
- 2008 Sediment Sample

Topography and Site Features
- Subject AOC
- AOC
- Slopes Greater Than 30 Degrees (As calculated from terrain model)
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

Notes:
Aerial photography: 2000 fly-over (AEROMAP)

The labeled anomalies are locations where the target appeared to be greater than 2 feet below mineral soil.

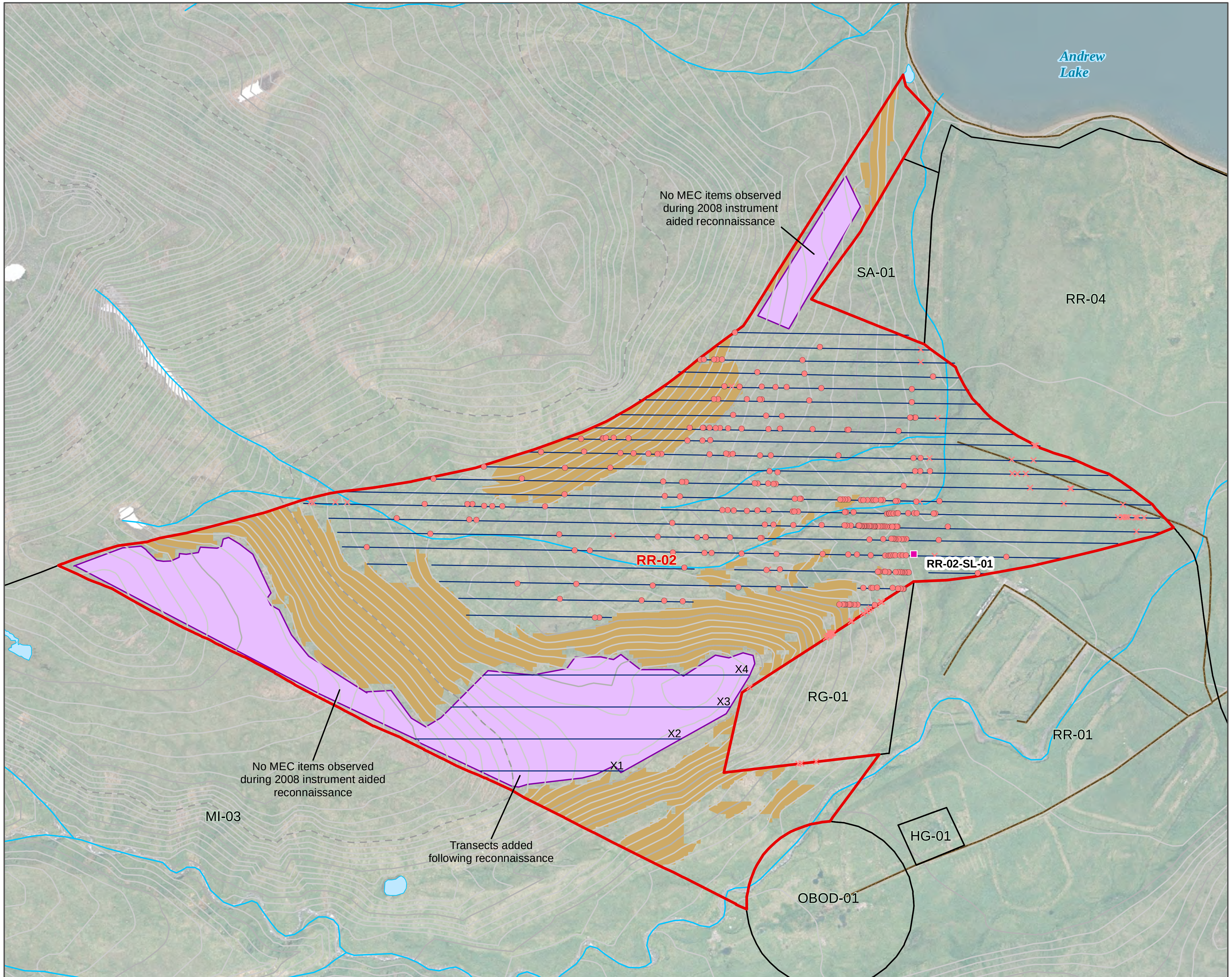
0 300 600
Feet

N

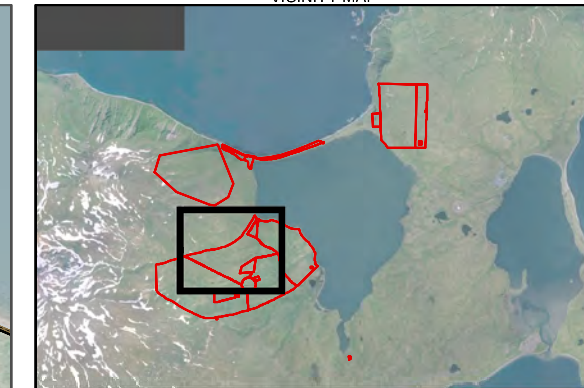
FIGURE 5-11
RR-01 2008 Investigation Results and Sample Locations
OU B-2 Remedial Investigation Report
Adak Island, Alaska

SEA \\JAFAR\PROJ\ADAK_335753\MAPFILES\RIFS_2011\INVESTIGATION2008_MAPBOOK.MXD RGRABARE 4/11/12 2:41:20 PM

CH2MHILL



VICINITY MAP



MEC Investigation

- 2008 Munitions Debris (MD)
- 2008 Other (not munitions-related material)
- 2008 Geophysical Survey Transect
- Instrument Aided Visual Reconnaissance

MC Investigation

- 2008 Soil Sample

Topography and Site Features

- Subject AOC
- AOC
- Slopes Greater Than 30 Degrees (As calculated from terrain model)
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

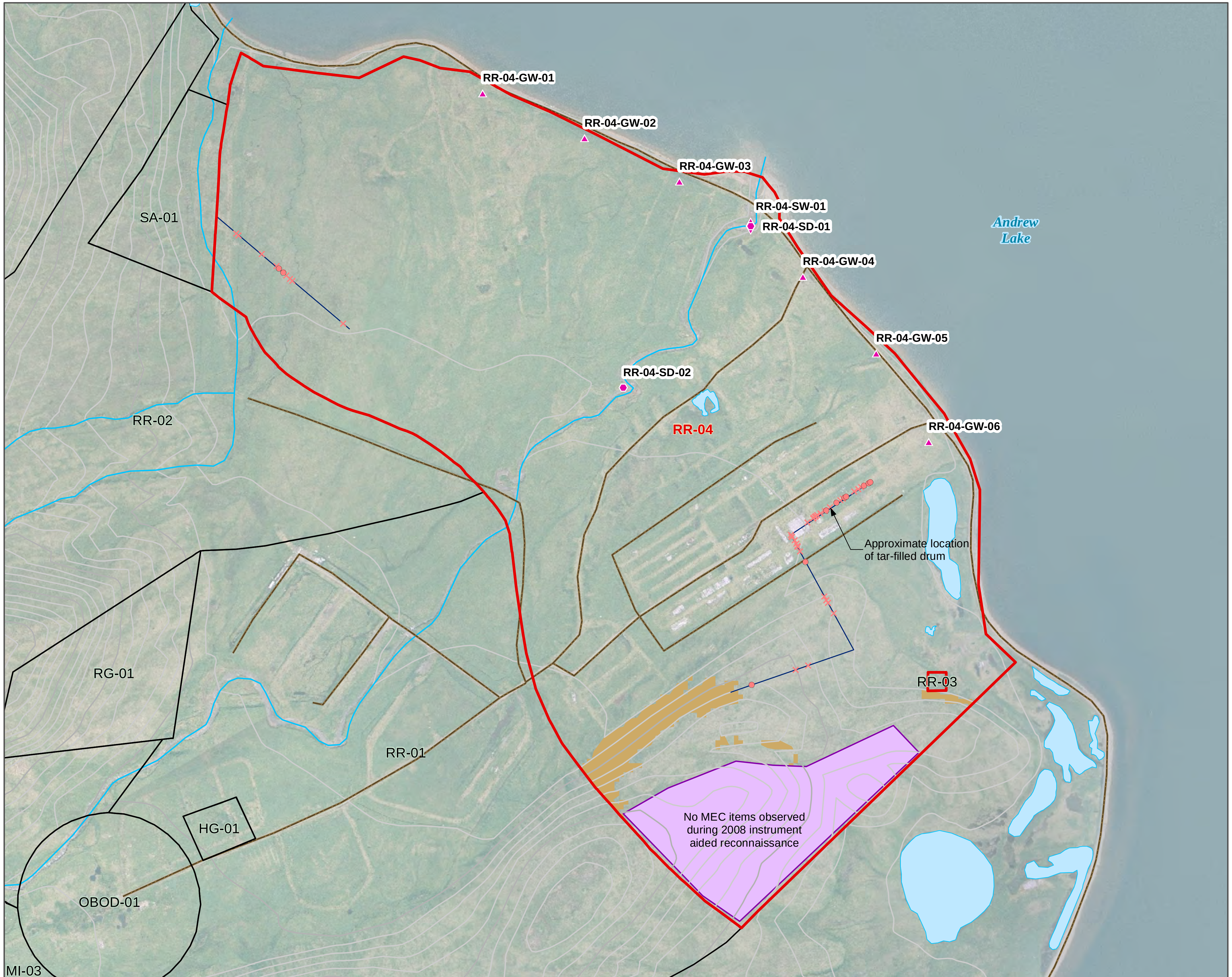
Notes:
Aerial photography: 2000 fly-over (AEROMAP)

0 400 800
Feet

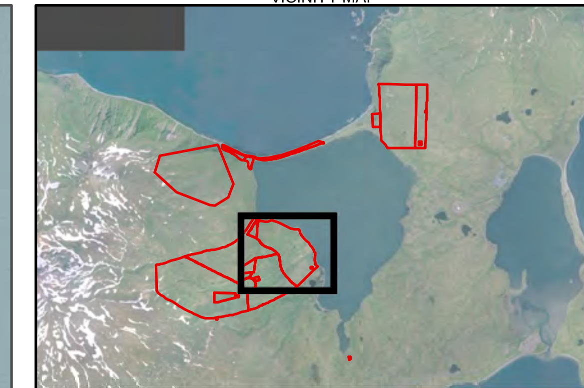
N

FIGURE 5-12
RR-02 2008 Investigation Results and Sample Locations
OU B-2 Remedial Investigation Report
Adak Island, Alaska

CH2MHILL



VICINITY MAP



MEC Investigation

- 2008 Munitions Debris (MD)
- 2008 Other (not munitions-related material)
- 2008 Geophysical Survey Transect
- Instrument Aided Visual Reconnaissance

MC Investigation

- 2008 Groundwater Sample
- 2008 Surface Water Sample
- 2008 Sediment Sample

Topography and Site Features

- Subject AOC
- AOC
- Slopes Greater Than 30 Degrees (As calculated from terrain model)
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

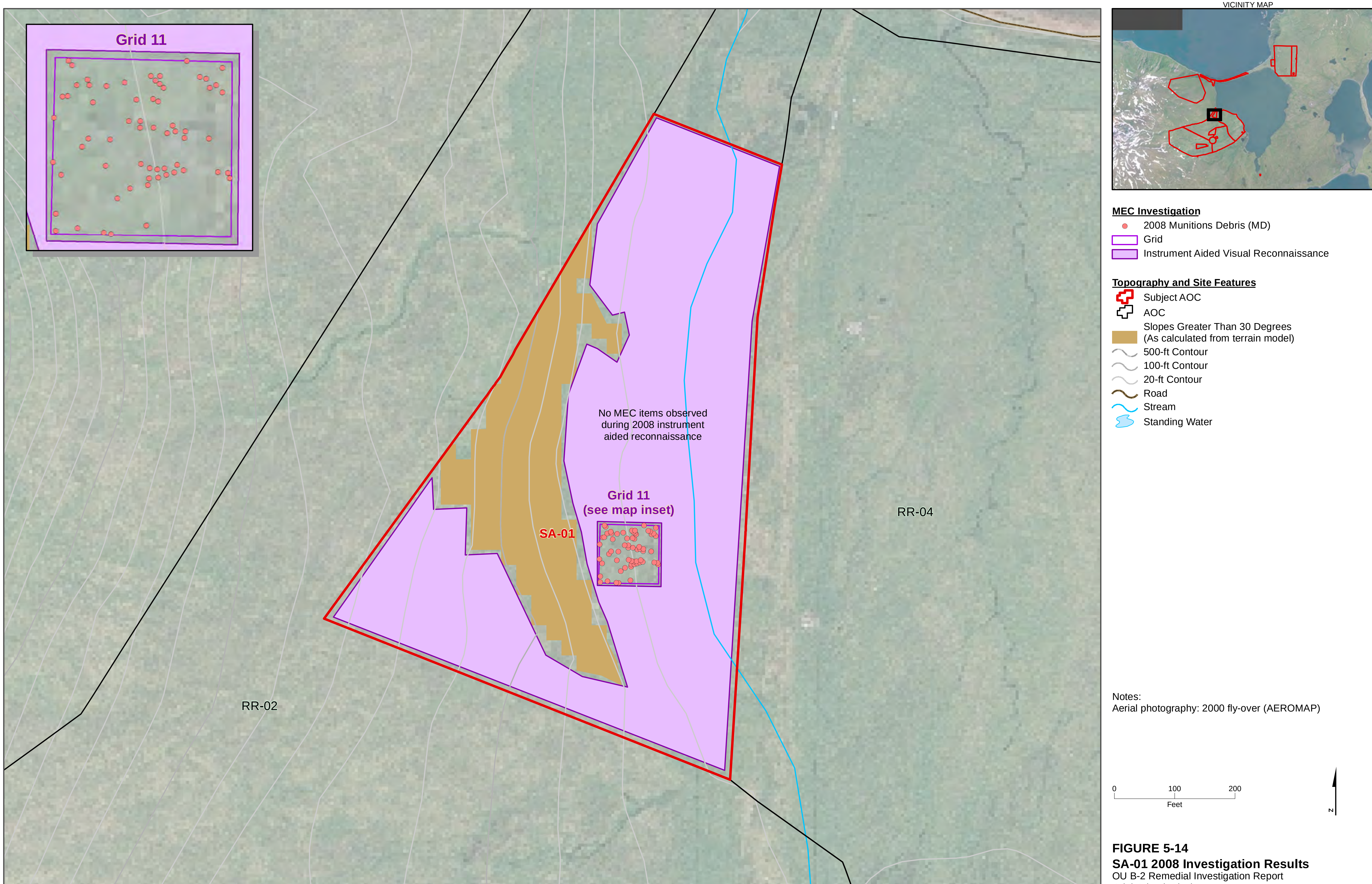
Notes:
Aerial photography: 2000 fly-over (AEROMAP)

0 370 740
Feet

N

FIGURE 5-13
RR-04 2008 Investigation Results and Sample Locations
OU B-2 Remedial Investigation Report
Adak Island, Alaska

CH2MHILL



Notes:
Aerial photography: 2000 fly-over (AEROMAP)

FIGURE 5-14
SA-01 2008 Investigation Results
OU B-2 Remedial Investigation Report
Adak Island, Alaska

CH2MHILL

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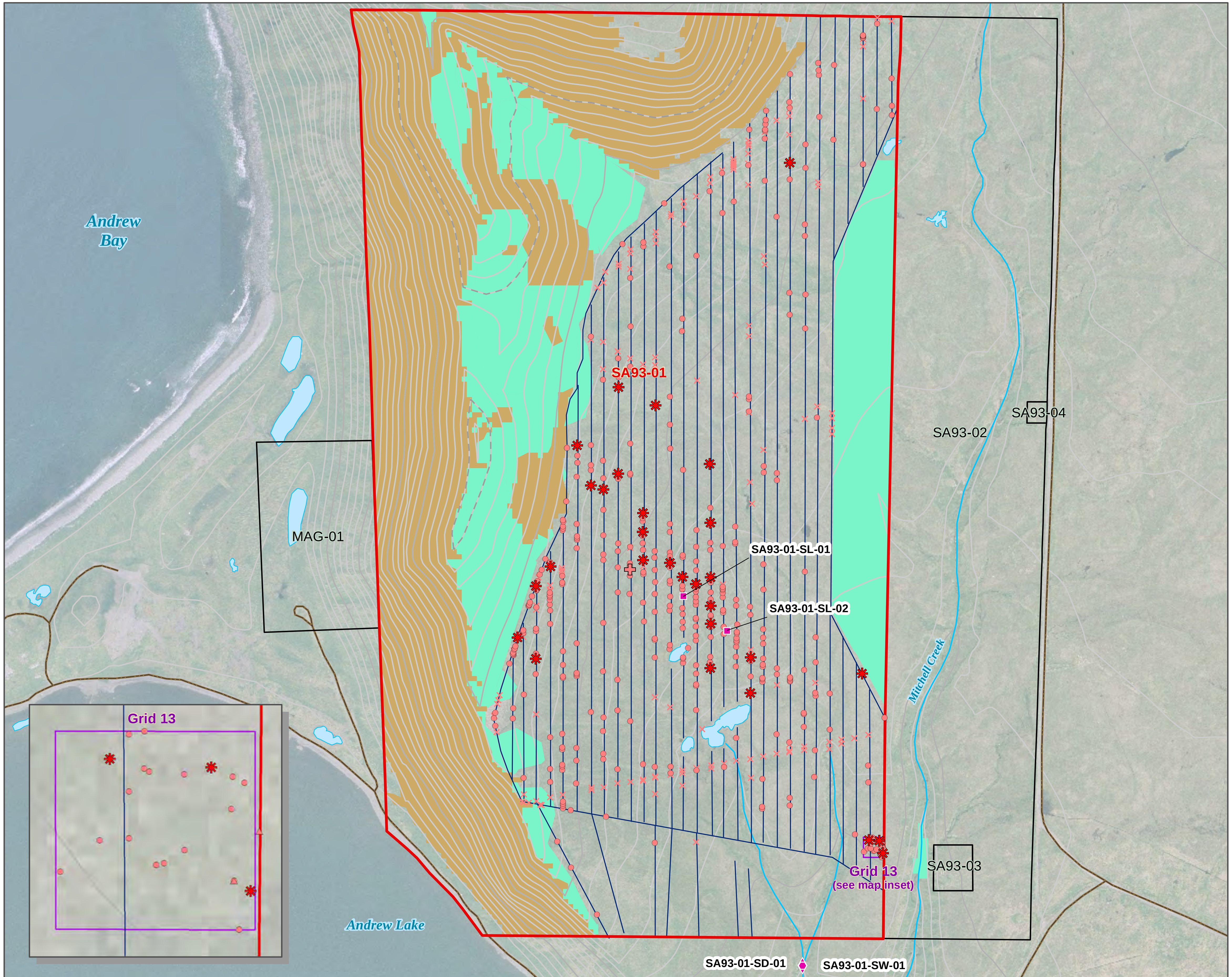
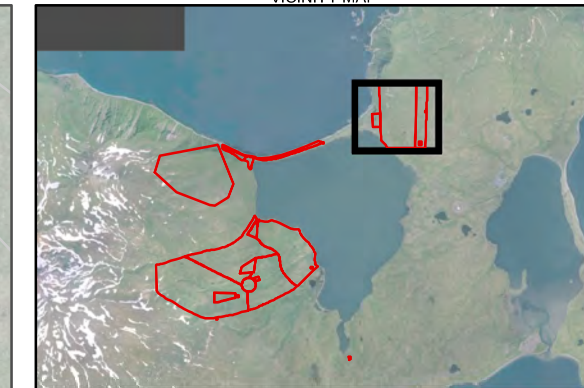


VICINITY MAP



MEC Investigation

- 2008 Unexploded Ordnance (UXO)
- 2008 Discarded Military Munitions (DMM)
- 2008 Material Presenting Potential Explosive Hazard (MPPEH)
- 2008 Munitions Debris (MD)
- 2008 Other (not munitions-related material)
- 2008 Geophysical Survey Transect
- Grid
- Accessibility Survey Area, Slopes Greater Than 30 Degrees

MC Investigation

- 2008 Surface Water Sample
- 2008 Sediment Sample
- 2008 Soil Sample

Topography and Site Features

- Subject AOC
- AOC
- Slopes Greater Than 30 Degrees (As calculated from terrain model)
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

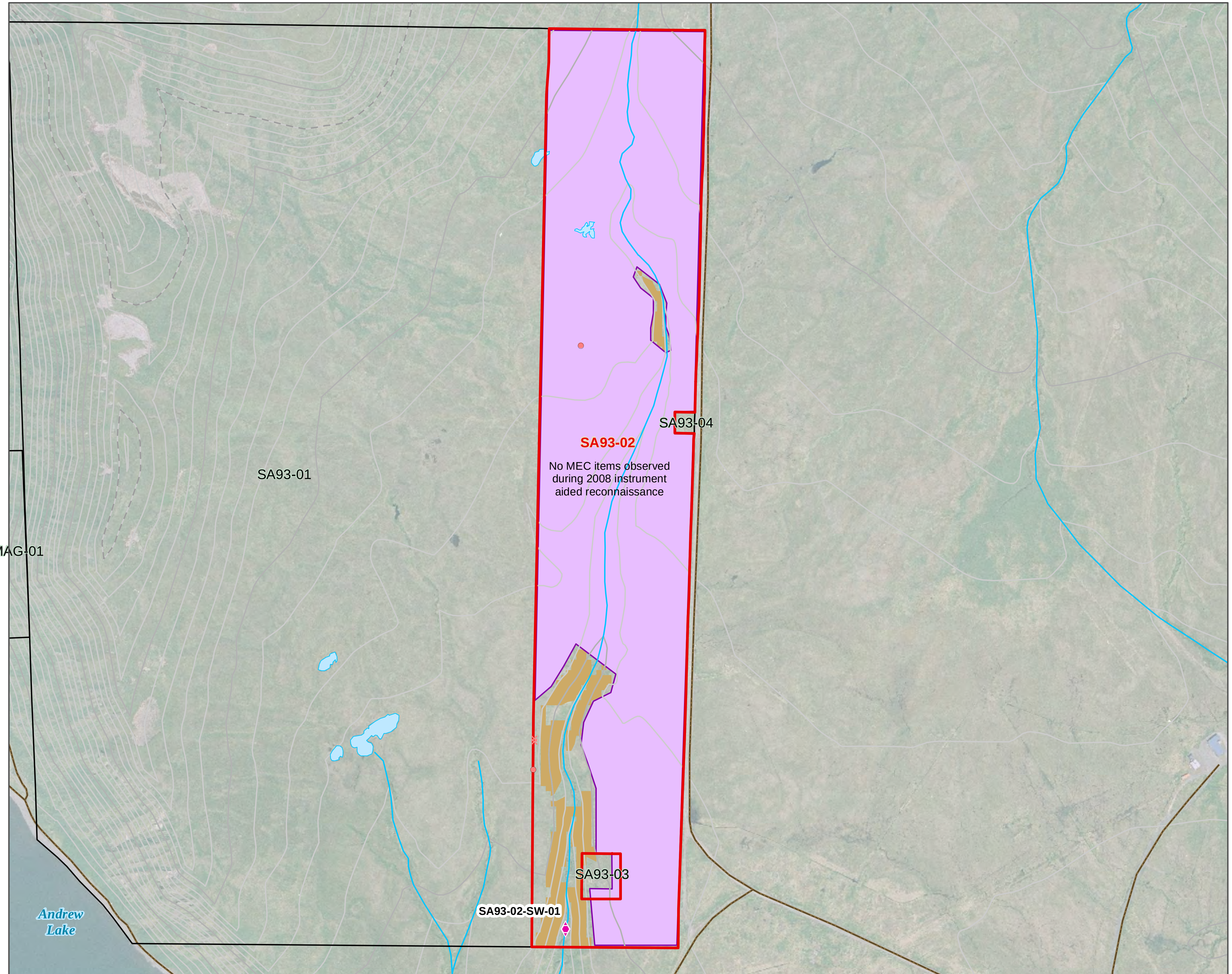
Notes:
Aerial photography: 2000 fly-over (AEROMAP)

0 335 670
Feet

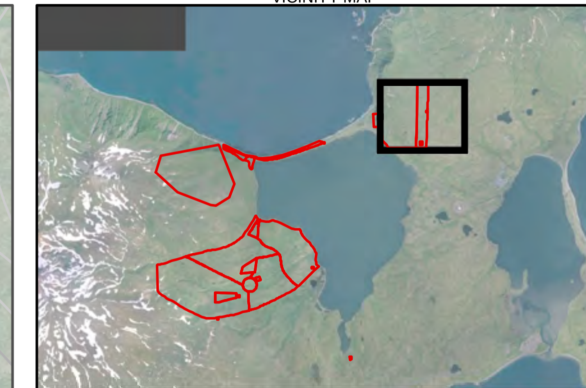
N

FIGURE 5-15
SA93-01 2008 Investigation Results and Sample Locations
OU B-2 Remedial Investigation Report
Adak Island, Alaska

CH2MHILL



VICINITY MAP



MEC Investigation
- 2008 Munitions Debris (MD)
- 2008 Other (not munitions-related material)
- Instrument Aided Visual Reconnaissance

MC Investigation
- 2008 Surface Water Sample
- 2008 Sediment Sample

Topography and Site Features
- Subject AOC
- AOC
- Slopes Greater Than 30 Degrees (As calculated from terrain model)
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

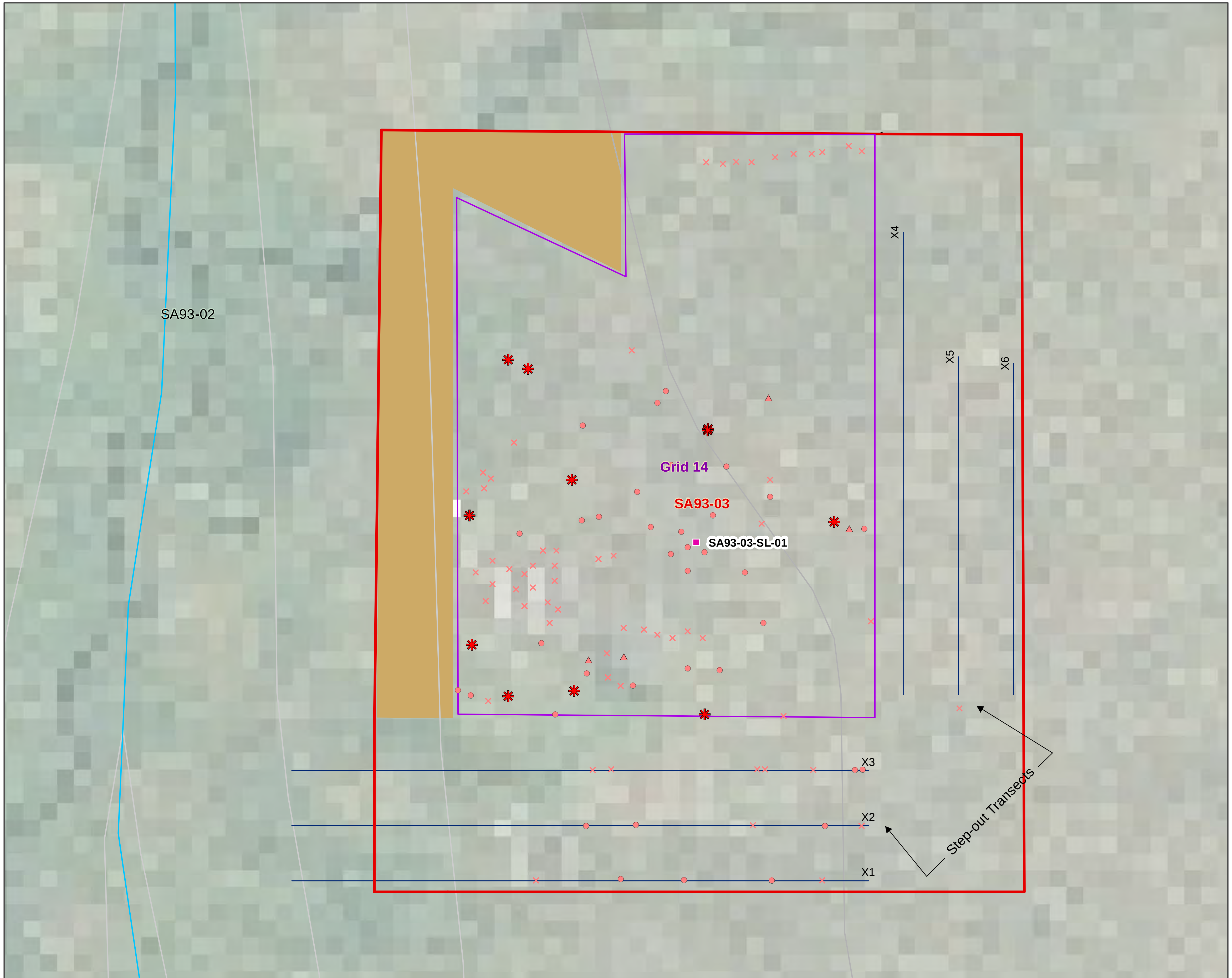
Notes:
Aerial photography: 2000 fly-over (AEROMAP)

0 335 670
Feet

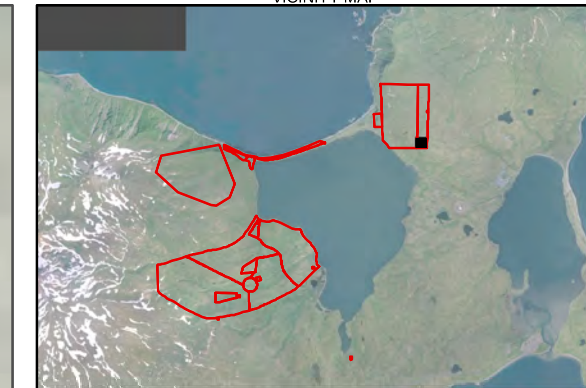
N

FIGURE 5-16
SA93-02 2008 Investigation Results and Sample Locations
OU B-2 Remedial Investigation Report
Adak Island, Alaska

CH2MHILL



VICINITY MAP



MEC Investigation
- 2008 Unexploded Ordnance (UXO)
- 2008 Munitions Debris (MD)
- 2008 Other (not munitions-related material)
- 2008 Geophysical Survey Transect
- Grid

MC Investigation
- 2008 Soil Sample

Topography and Site Features
- Subject AOC
- AOC
- Slopes Greater Than 30 Degrees (As calculated from terrain model)
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

Notes:
Aerial photography: 2000 fly-over (AEROMAP)

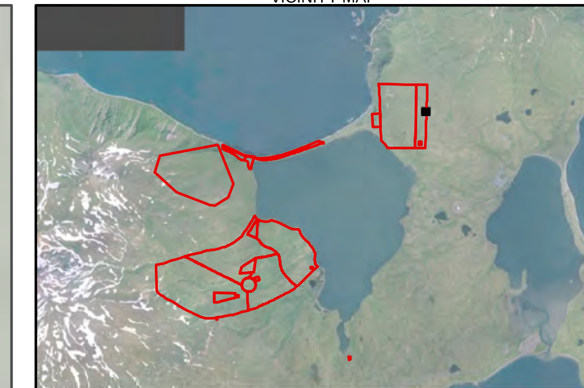
0 20 40
Feet

N

FIGURE 5-17
SA93-03 2008 Investigation Results
OU B-2 Remedial Investigation Report
Adak Island, Alaska

CH2MHILL

VICINITY MAP



MEC Investigation

Instrument Aided Visual Reconnaissance

Topography and Site Features

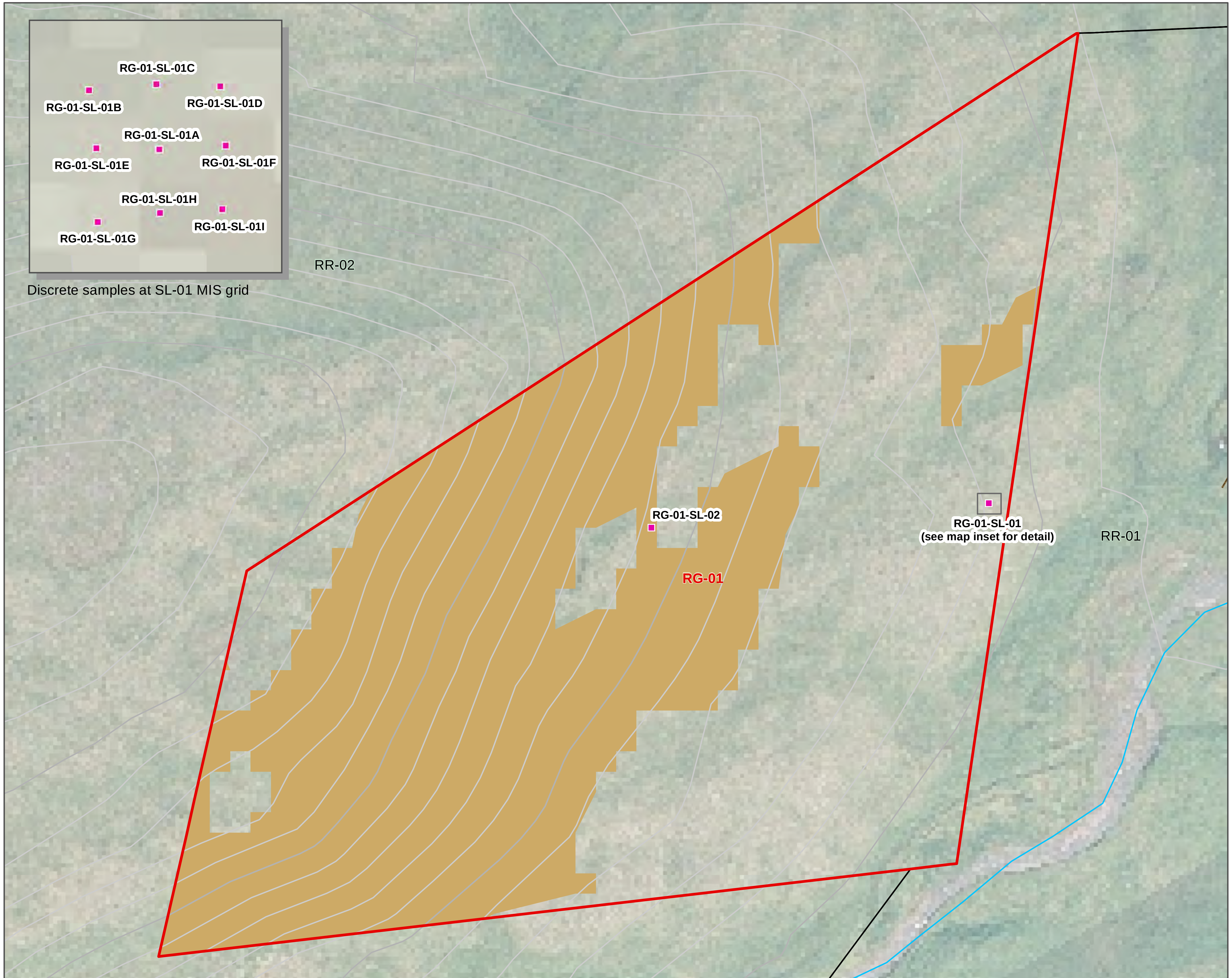
Subject AOC
AOC
Slopes Greater Than 30 Degrees (As calculated from terrain model)
500-ft Contour
100-ft Contour
20-ft Contour
Road
Stream
Standing Water

Notes:
Aerial photography: 2000 fly-over (AEROMAP)

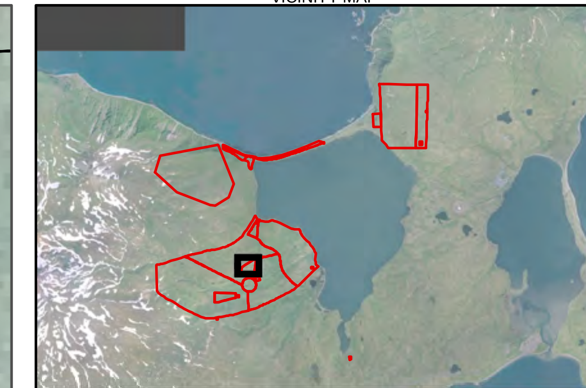
0 10 20
Feet

N

FIGURE 5-18
SA93-04 2008 Investigation Results
OU B-2 Remedial Investigation Report
Adak Island, Alaska



VICINITY MAP



MC Investigation

2008 Soil Sample

Topography and Site Features

Subject AOC

AOC

Slopes Greater Than 30 Degrees (As calculated from terrain model)

500-ft Contour

100-ft Contour

20-ft Contour

Road

Stream

Standing Water

Notes:
Aerial photography: 2000 fly-over (AEROMAP)

0 80 160
Feet

N

FIGURE 5-19
Sample Locations
OU B-2 Remedial Investigation Report
Adak Island, Alaska

CH2MHILL

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SECTION 6

Additional Work (2008 through 2012)

This section provides summaries of additional studies and field investigations conducted at OU B-2 following completion of the 2008 RI field work. The purpose of the additional work was to obtain additional information concerning historical activities at certain AOCs and to better characterize the natural and cultural resources at OU B-2.

6.1 2010 Andrew Bay Data Collection Assessment

During the course of the 2008 RI, it was recognized that there were insufficient data to evaluate the nature and extent of MEC at ALSW-01 based on historical and continuing observations of accumulated MEC on the seawall and adjacent tidelands. In response to these uncertainties, the Navy agreed to collect available historical information about possible offshore munitions disposal near ALSW-01 and also to support remedial decision-making by evaluating the feasibility of collecting MEC-related data of known and usable quality from the marine source area at ALSW-01. Conceptual remedial approaches were developed in concert with the review and evaluation to identify any further data gaps to be addressed, to aid in developing data quality objectives, and to aid in framing questions for upcoming remedial decision-making. Finally, the practicability, costs, and long-term effectiveness of a potential data collection effort and remedial action were evaluated. The results of the study were documented in a technical memorandum (US Navy, 2011) and have been incorporated into the relevant sections of this report, as well as the Final FS Report.

6.2 Historical Photographic Analysis

In 2011, the US Army Geospatial Center (AGC) conducted a review of historical aerial photograph, maps, and other documents in order to characterize historical conditions and identify potential locations of historical firing ranges, impact areas, and munitions disposal areas at OU B-2. The findings of the review did not result in changes to the CSMs for most OU B-2 AOCs. However, the analysis found evidence of possible waste disposal in the vicinity of ALDA-02, which was not consistent with the CSM previously developed for the AOC (bombing range). The results of the analysis were documented in a report (AGC, 2011) and are incorporated into the relevant sections of this report, as well as in the Final FS report. A copy of the report is provided as Appendix G.

6.3 Cultural Resources Survey

The cultural resources survey at OU B-2 was conducted by the URS Group Inc. (URS Group) in September 2011. The survey focused on AOCs where MEC had been previously found and remedial action was anticipated. Five of these AOCs were closely examined for the presence of cultural resources, including prehistoric sites and historic features associated with World War II (WWII) and Cold War activities. The cultural resources survey was conducted to assist the Navy in complying with stipulations of Sections 106 and 110 of the National Historic Preservation Act. Sites that received an intensive cultural resources survey (10-meter pedestrian transects) included OB/OD-01, the southern part of RR-01, ALDA-01, and ALSW-01, while HG-01 and the northern part of RR-01 were examined with more widely spaced 30-meter transects.

The survey effort resulted in the identification and recordation of 10 cultural resources, including 7 historic sites and 3 historic isolates. No prehistoric cultural material was encountered. The seven historic sites recorded within OU B-2 consist of an underground bunker and four Quonset hut depressions at ALDA-01; an underground bunker at ALSW-01; a hand grenade range containing protective walls, bunkers, and a magazine at HG-01; two diversion dams at MI-03; three collapsed wooden structures and an abandoned bridge at OB/OD-01; and a rifle range at RR-01. The three historic isolates include a debris scatter at OB/OD-01 and an iron logging yarder and scattered segments of a redwood water pipeline at RR-01. Other than the newly discovered resources, no previously recorded cultural resource occurs within the project area.

The results of the survey were documented in a report (US Navy, 2012a) and are incorporated into the relevant sections of this report as well as in the Final FS report. A copy of the draft report is provided as Appendix H.

6.4 Wetlands Survey

The wetlands survey at OU B-2 was conducted by the URS Group in September and October 2011. The survey focused on 11 AOCs where MEC had been previously found and remedial action was anticipated. Wetland determinations were made on site by wetland biologists using standard methodologies outlined in the 1987 *Corps of Engineers Wetlands Delineation Manual* (USACE 1987). The delineation methodology was further refined using the 2007 *Regional Supplement to Corp of Engineers Wetland Delineation Manual: Alaska Region (Version 2.0)* (USACE 1987 and 2007).Wetlands were mapped using a combination of Global Positioning System (GPS) and hand notations on field maps. Wetlands were classified under hydrogeomorphic (HGM) and Cowardin classification systems. A qualitative wetland functions assessment was conducted based on a “Best Professional Judgment Characterization” provided by the U.S. Army Corps of Engineers Alaska District Regulatory Branch (USACE 2009), as well as interpretations from the HGM classification. Seventy-five wetlands were delineated within the study area. These wetlands range in size from less than 0.01 acre to over 40 acres. A total of 117.58 acres of wetlands were identified across the surveyed areas.

The results of the survey were documented in a report (US Navy, 2012b) and are incorporated into the relevant sections of this report as well as in the Final FS report. A copy of the draft report is provided as Appendix I.

6.5 Threatened and Endangered Species Survey

A wildlife and habitat field survey and a literature review were conducted by the URS Group in September and October 2011. The survey focused on 11 AOCs where MEC had been previously found and remedial action was anticipated and encompassed all habitats and species with potential to occur in the vicinity of the OU B-2 sites. All 11 sites were visited to observe and record wildlife habitat and species. Focused surveys occurred for two species: Aleutian shield fern (*Polystichum aleuticum*) and Kittlitz’s murrelet (*Brachyramphus brevirostris*). A stream assessment was conducted for Moffett Creek and the lower part of Mitchell Creek to locate and map potential spawning areas for salmon. In addition, a reconnaissance-level field survey of existing habitats was conducted on foot in both terrestrial and tidal areas at OU B-2 sites.

The study also included a literature review of wildlife species for the survey area. The literature review identified ample information on species occurrence and life histories from previous years to supplement field observations.

Seven species listed under the Endangered Species Act (ESA) regularly occur on or in the vicinity of Adak Island. They are blue whale, fin whale, humpback whale, northern (Alaska) sea otter, sei whale, northern (Steller) sea lion, and Aleutian shield fern. The northern sea lion rests and spends a portion of its breeding cycle on the marine shoreline. The nearest rookery is on Adak’s southwest coast, well away from the OU B-2 sites. The remaining species, with the exception of Aleutian shield fern, are almost entirely confined to the marine environment.

At the time of the survey, the proposed project activities did not include any offshore work in Andrew Bay. If that should change in the future, the Navy would be required to initiate formal consultation with National Oceanic and Atmospheric Administration Fisheries under the ESA for to northern sea otter.

The only site in the study area with potential habitat for Aleutian shield fern was C1-01. However, C1-01 lacks certain preferred habitat elements, including steep ledges and overhangs. No Aleutian shield fern plant was found during the 2011 field survey.

Kittlitz’s murrelet is known to nest on high elevation rocky slopes and overwinter in marine waters on Adak Island. There is suitable nesting habitat for this species within Site C1-01. Kittlitz’s murrelet is currently a candidate for listing under the ESA and is expected to be listed or removed from the candidate list by the end of 2013.

The results of the survey were documented in a preliminary report (US Navy, 2012c) and are incorporated into the relevant sections of this report as well as in the Final FS report. A copy of the preliminary report is provided as Appendix J.

6.6 Andrew Bay Sediment Dynamics Study Update

The Navy is in the process of updating the 2002 Andrew Bay Sediment Dynamics Study to better understand the mobility of munitions in the offshore and intertidal portion of ALSW-01. The study is being conducted by University of California, under the direction of Dr. Scott Jenkins. Results of the study will be reported in a technical memorandum and will be used to inform decision-making about the locations and frequency of future beach sweeps.

SECTION 7

Nature and Extent of Contamination

This section summarizes the nature and extent of contamination at the OU B-2 AOCs. The section begins with a description of the evaluation approach and decision criteria used in the nature and extent evaluation for each AOC. It also describes the Level 2 methodology requirements for characterizing the nature and extent of MEC and MC at OU B-2. The remaining subsections present the results of these evaluations for each AOC.

7.1 Evaluation Approach

Data from the 2008 field investigation (Section 5.4), previous investigations (Section 4.3), and additional studies (Section 6) were integrated and evaluated to characterize the nature and extent of MEC and MC contamination at the OU B-2 AOCs. The data used to complete the MC evaluation included soil, sediment, and surface water samples collected during previous investigations and soil, sediment, surface water, and groundwater samples collected during the 2008 investigation.

The nature and extent evaluation for each AOC has three components:

- Nature and extent of MEC and potential for erosion and offsite transport of MEC
- AOC type confirmation and Level 2 methodology status
- Nature and extent of MC

The following data were used to complete the nature and extent evaluation for MEC at each AOC:

- Reconnaissance observations concerning site accessibility and the potential for MEC to be transported beyond AOC boundaries by erosion or slope failure Instrument-aided visual surveys for the presence of MEC
- Geophysical and intrusive investigation data

The nature and extent of MEC at each AOC was evaluated by mapping the distributions of finds using instrument-aided visual inspection, as well as geophysical and intrusive investigation data from previous investigations and from the 2008 field investigation. The completeness of MEC characterization for each AOC was determined in accordance with the 2008 RI Work Plan, MEC QAPP DFW, and SOP requirements by reviewing maps of geophysical transect/grid coverage, intrusive investigation results, and information about accessibility and visual observations. Boundary confirmation was conducted by reviewing the distribution of MEC across the AOC and in adjacent AOCs, and by determining whether all identified MEC was located within 15 meters of the previously determined boundaries. If MEC was found within the safety buffer, the intrusive data for the AOC, step-out transects, and adjacent sites were evaluated to determine whether the AOC should be expanded or combined with an adjacent or surrounding AOC to form remedial action areas.

The potential for erosion and offsite transport of MEC was evaluated by reviewing the reconnaissance reports for locations of erosion features, unstable slopes, and other areas deemed likely to erode within an AOC, then determining whether MEC was present in the vicinity of such areas based on a review of intrusive investigation result maps. If no MEC was present in the vicinity, or if the unstable/erodible slopes were not near AOC boundaries, the potential for offsite migration was determined to be low. Otherwise, further evaluation of possible offsite movement of MEC downstream of the AOC was required. The potential for erosion and offsite migration of MEC was found to be low at all AOCs examined for such characteristics.

AOC type confirmation was accomplished by (1) reviewing reconnaissance observations and geophysical and intrusive investigation data from previous investigations plus the 2008 field investigation, and (2) comparing the types and distributions of MEC found at each AOC with the identified AOC type. If items found during the intrusive investigation were different than expected, or if the distribution patterns or penetration depths for UXO were contrary to those expected, the AOC type was reevaluated and modified to reflect the items and conditions encountered at the AOC. The work conducted at the AOC was then reevaluated under the Level 2 methodology requirements for the appropriate AOC type.

The nature of potential MC contamination in soil, sediment, surface water, and groundwater was characterized by comparing the individual sample results collected at the AOC (including samples collected during previous investigations) with conservative risk-based screening levels that were presented in Appendix B of the RI Work Plan. These screening levels accounted for direct exposure of human and ecological receptors to MC[1] and for potential offsite transportation and subsequent exposure of human and ecological receptors to MC. If the detected concentrations of one or more constituent were above their respective screening levels, then additional sampling or evaluation to characterize the extent of contamination was required. Otherwise, no additional sampling or evaluation was necessary to establish extent.

7.2 Evaluation Results

This section provides the results of the nature and extent evaluations, including a review of field investigations conducted through 2008, nature and extent of MEC, Level 2 methodology status, and MC evaluation findings.

Note: Because of their size, Figures 7-1 through 7-22 are located at the end of the section rather than integrated with the text.

7.2.1 ALDA-01

ALDA-01 is a disposal area adjacent to the northwest corner of Andrew Lake. There are several large craters scattered across the surface of this AOC.

7.2.1.1 Investigation History

The 1999 SI at ALDA-01 included a surface sweep to remove metallic debris and MEC, followed by a ribbon walk. Several MEC items were found at the surface and, based on the presence of several large surface craters, were suspected to have come from possible use of the area for demolition. The ribbon walk was modified to a 100 percent grid because of the large number of anomalies discovered. More than 900 targets were identified, with individual targets difficult to discern in many areas (Figure 7-1). As a result, six representative target areas were chosen for investigation using a trackhoe. Trenches and test pits were dug to a depth of 4 feet to investigate the dense anomalies. At the longest investigation trench, 500 pounds of scrap metal were removed. In addition, 33 individual targets were also investigated in southern parts of the AOC where it was possible to isolate targets. Although items found buried in the area consisted mostly of metal debris, DMM was also found.

The 2008 RI included an instrument-aided evaluation of four craters, as well as collection of one three-point composite soil sample and field duplicate for MC analyses within one crater. Four possible detonation craters located in the center of the AOC were investigated using mag and dig procedures**,** and only non-munitions-related metal debris and frag were found. In addition, the northern portion of ALDA-01 was included in the grid (Grid 12) at ALSW-01, which was intended to identify the possible location of a small arms burial area, and in the instrument-aided visual inspection used to better determine the extent of metal debris possibly employed in construction of the seawall (see Section 6.2.3). Items found in ALDA-01 during the course of the intrusive investigation at Grid 12 and the western transect included metal waste, cables, angle irons, and other non-munitions-related debris; no MEC was found.

7.2.1.2 Nature and Extent of MEC

Materials found in the subsurface during 1999 consisted of DMM and MPPEH (60-mm mortar bodies, 40 mm MK II [unfuzed/unfired]); an M47A2 incendiary gasoline gel bomb case with possible burster tube and residue; and a variety of metal debris intermingled with rocks on surface and subsurface. Only metal debris found in 2008 crater investigation. On the basis of observations from the trenching investigation, buried debris extends at least 4 feet bgs.

[1] Samples collected during previous investigations were analyzed for a broad list of target analytes, including volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, and total petroleum hydrocarbons (TPH). The 1996 screening level risk assessment and 1997 detailed risk assessment (URS, 1997) found that these types of chemicals did not pose unacceptable risk to human or ecological receptors. Therefore, only the MC results from these earlier investigations are considered in the MC evaluation.

The approximate extent of the disposal area was determined by the 1999 geophysical survey, which found anomalies extending throughout the survey area (Figure 7-1). The geophysical survey did not extend beyond the apparent disposal area, and numerous anomalies are located on the margins of the survey area. However, based on the topography of the uninvestigated areas to the west and south, as well as the proximity of Andrew Lake to the east, it is unlikely that the disposal area extends much beyond the limits of the survey area. The northern extent of the disposal area has not been defined because it is indistinguishable from metal debris in the seawall berm. The degree to which MEC is present in the northern portion of the disposal area is unknown; the limited intrusive investigation of anomalies in Grid 12 found only metal debris to a depth of 2 feet.

7.2.1.3 AOC Type and Level 2 Methodology Status

Conditions at ALD0-01 are consistent with the identified AOC type (Disposal Area). Only non-munitions-related metal debris was found in the 2008 crater investigation, indicating that possible use of the area as an OB/OD Area (if at all) appears to have been limited. The MEC found at the surface in 1999 may be related to such use, or it may have been washed into the area from an offshore area storm events.

Investigations conducted to date at ALDA-01 only partially fulfill Level 2 methodology requirements for a disposal area because a 100 percent intrusive investigation of all identified anomalies has not been conducted. However, sufficient information has been gathered to make a determination about potential hazards and to evaluate potential remedies to address the hazards in the FS.

7.2.1.4 Nature and Extent of MC

No MC was detected in a soil sample collected at one of the blast craters (Table 5-14a), and no other potential sources of MC (i.e., breached munitions) were found. On the basis of these results, the surface soil at ALDA-01 does not appear to have been affected by releases of MC.

7.2.2 ALDA-02

ALDA-02 is located adjacent to the beaches of Andrew Bay and northwest of Andrew Lake in the northwestern portion of OU B-2. This AOC is roughly rectangular, with the long sides of the rectangle running parallel to the Andrew Bay shoreline. It may have been used as an aerial bombing range or for MEC disposal, based on the presence of a line of craters paralleling the shoreline.

7.2.2.1 Investigation History

Site walks by Project Team members and UXO professionals were conducted at this AOC in 2000. Conditions noted during the site walks included rugged terrain, exposed bedrock, and steep slopes. No MEC items were found during the walks. No geophysical surveys or intrusive investigations were performed because the terrain is steep (Figure 7-2) and bedrock is shallow in this area, making it difficult to walk or dig. In 2008, one sediment sample was collected from the bed of the stream that originates in C1-01 and flows to the north through ALDA-02 into Andrew Bay. In addition, the western transect at ALSW-01 extended into ALDA-02 and no surface or subsurface MEC was found.

7.2.2.2 Nature and Extent of MEC

ALDA-02 was characterized as NOFA for MEC prior to the 2008 RI because no MEC items were found and because bedrock is shallow, which would promote high-order detonation of any bombs dropped. Additional site reconnaissance to evaluate possible MEC disposal will be performed in 2012.

7.2.2.3 AOC Type and Level 2 Methodology Status

Site use may not be consistent with AOC type (aerial bombing range), based on recent examination of historical aerial photographs and maps. Investigations conducted to date do not meet Level 2 methodology requirements for aerial bombing range or MEC disposal area. However, site conditions may not be suitable for completion of geophysical survey and intrusive. Additional information will be gathered during a 2012 site reconnaissance to evaluate possible MEC disposal in the AOC.

7.2.2.4 Nature and Extent of MC

Concentrations of all target analytes were below detection limits in a sediment sample collected at ALDA-02 (Table 5-10). On the basis of these results, the sediment at ALDA-02 does not appear to have been affected by releases of MC in ALDA-02 or in the upstream C1-01.

7.2.3 ALSW-01

ALSW-01 consists of the western portion of the seawall located along the north shoreline of Andrew Lake. The seawall is narrow and elongated, similar to a dike with a narrow flat top and steep sides. The seawall separates the freshwater lake from Andrew Bay. The source of the MEC found along the seawall appears to be located offshore.

7.2.3.1 Investigation History

Previous and ongoing work at ALSW-01 includes annual surface sweeps to remove washed-up MEC. MD and metal debris have also been found at the surface during annual surface sweeps.

The 2008 work at ALSW-01 focused on possible subsurface MEC. It included the following:

- A geophysical survey and limited intrusive investigation along transects that followed the top and sides of the seawall east of the spillway
- An instrument-aided visual inspection west of the spillway
- A 100 percent geophysical survey and limited intrusive investigation of a 30-m by 30-m grid at the expected location for a small arms burial area

The intrusive investigations that followed the 2008 surveys were limited because of the extremely rough and cobbly nature of the seawall, as well as the high density of anomalies caused by the presence of large metal debris in the seawall.

7.2.3.2 Nature and Extent of MEC

Items found at surface during annual surface sweeps consist of a variety of MEC (e.g., 60 mm and 81 mm mortars, various fuzes, thermite bomblets, thermite grenades, M52 incendiary bomb), MD, and metal debris. Most items found during these sweeps are highly weathered and appear to have transported to the shore by waves and currents, as there are no known current or recent land-based activities that could reasonably have resulted in the deposition of MEC along the seawall. The extent of the offshore MEC source area has not been established.

No MEC items or evidence of small arms burial were found at any of the subsurface targets investigated in 2008. In addition, the rough and cobbly nature of the seawall would limit penetration of MEC and also serve to control casual access to the subsurface. As a result, the potential for substantial MEC in the subsurface at ALSW-01 is considered low.

7.2.3.3 AOC Type and Level 2 Methodology Status

There is no Level 2 methodology for a wash-up area. The work conducted to date at ALSW-01 partially satisfies the Level 2 methodology requirements for a large-scale burial/disposal area. However, sufficient information has been gathered to make a determination about potential hazards and to evaluate potential remedies to address the hazards in the FS.

7.2.3.4 Nature and Extent of MC

No samples were collected for MC analysis at ALSW-01 because no breached munitions or other apparent sources were found.

7.2.4 BC-03

BC-03 is located atop the Andrew Lake seawall, near the center of the dike-like feature. This AOC is a small, roughly square site that is surrounded on all sides by land that is not part of OU B-2. This AOC was a firing point for 155 mm projectiles.

7.2.4.1 Investigation History

The 1999 investigation at BC-03 consisted of 100 percent instrument-aided reconnaissance of accessible areas, with all contacts intrusively investigated to a depth of 4 feet. Only non-munitions-related metal debris was found (Figure 7-4).

7.2.4.2 Nature and Extent of MEC

No MEC was found during the 1999 investigation.

7.2.4.3 AOC Type and Level 2 Methodology Status

All Level 2 methodology requirements for a firing point have been fulfilled. BC-03 was characterized as NOFA prior to the 2008 RI because the area had been fully investigated and only metal debris was found.

7.2.4.4 Nature and Extent of MC

No potential sources of MC were found at BC-03, and no samples were collected for MC analysis.

7.2.5 C1-01

C1-01 is located north of the former Range Complex at Andrew Lake. It is situated on a sloping plateau above and west of ALDA-01 on the flanks of Mt. Moffett. This AOC was identified initially as a combat range/maneuver area, but it was reclassified as a target/impact area after the 1999 SI. Target munitions at CI-01 included 20 mm, 37 mm, and 40 mm projectiles, as well as 60 and 81 mm mortars.

7.2.5.1 Investigation History

Previous work at C1-01 included a ribbon walk geophysical survey in 1999. It was followed in 2000 by (1) mapping of 45.5 miles using the 34.5-foot transect pattern to fill in gaps in the characterization pattern for 60 mm mortars (believed to be the smallest munitions in C1-01 at the time of the investigation) and (2) intrusive investigation of anomalies. During the 1999 and 2000 surveys, 648 targets (100 percent) were intrusively investigated to a maximum depth of 4 feet. Items found consisted of UXO (60 mm and 81 mm mortars; 20 mm, 37 mm, and 40 mm projectiles) and MPPEH. The MEC items were typically encountered within 2 feet of the surface, and all encountered MEC items were recovered and destroyed.

Work conducted in 2008 included the following:

- An accessibility assessment of the areas outside the boundary of this AOC where UXO and MD were found during the 2000 investigation
- Site reconnaissance for features indicative of erosion and instability
- Collection of a soil sample at a breached munitions location identified during the 2000 investigation

7.2.5.2 Nature and Extent of MEC

The approximate extent of the target/impact area at this AOC was determined by DGM survey and intrusive investigation. It encompasses the portion of C1-01 where UXO and MD were found (Figure 7-5).

UXO and MPPEH were found beyond the eastern boundary of this AOC, indicating that C1-01 extends farther east or that MEC was eroded and transported beyond the boundary at some time in the past. Additional surveys to determine the eastern extent of this AOC or to characterize the extent of possible offsite transport are not feasible because the land surrounding the AOC is steeply sloped.

7.2.5.3 AOC Type and Level 2 Methodology Status

The distribution of MEC at C1-01 is consistent with the AOC type (target/impact area). Work conducted to date satisfies the Level 2 methodology requirements for assessment of a target/impact area, but it does not address the presence and associated transect width for 20 mm projectiles.

7.2.5.4 Nature and Extent of MC

No MC was detected in a soil sample collected at a breached munitions location (Table 5-9), and no MC was detected in a sediment sample obtained downstream of C1-01 in ALDA-02 (Table 5-10). On the basis of these results, the environmental media at and downstream of C1-01 do not appear to have been affected by releases of MC.

7.2.6 HG-01

HG-01 is a small, square area of about 2 acres located within the former Range Complex at Andrew Lake. This AOC is located wholly within RR-01 and was used for grenade practice. Remnants of a berm with incorporated throwing pits are located near the east side of the range. The pits are reinforced with heavy timbers and, at one time, offered protection from exploding grenades during training exercises. Target munitions at HG-01 included 40 mm grenades and 60 mm mortars.

7.2.6.1 Investigation History

Previous work at HG-01 included a ribbon walk in 1999 that covered a route 1 meter wide and 4.85 miles long. It provided about 80 percent geophysical coverage of this AOC. One hundred and eighty (180) targets were identified and 155 targets were intrusively investigated. During the 1999 investigation, M441 40 mm grenades, 60 mm mortars (unfuzed) and related waste, several CADs, a dummy 3.5-inch rocket, and numerous pieces of unidentified fragments were found within 2 feet of the surface.

The 2008 investigation included intrusive investigation of the 25 uninvestigated target anomalies identified in 1999, and geophysical and intrusive investigation of two 30-m by 30-m grids (Grids 9 and 10) centered on the locations of two prior MEC discoveries. The 25 historical targets at HG-01 were found to be MD and non-munitions-related waste. Two UXO items (40 mm projectiles) were found in portions of Grid 9 that had been fully investigated and cleared in 1999. The 1999 data for this area were reviewed and there is no information that indicates why these items were missed. One UXO item was located on the eastern boundary of Grid 9. However, no expansion grids or step-out transects were conducted because no MEC items were found along the adjacent RR-01 transects.

7.2.6.2 Nature and Extent of MEC

The approximate extent of the MEC-affected area has been determined and all anomalies have been investigated (Figure 7-6). All MEC items were found within 2 feet of the surface and were recovered and destroyed.

7.2.6.3 AOC Type and Level 2 Methodology Status

Conditions at HG-01 are consistent with its identified AOC type (target/impact area). The work conducted to date fulfills the Level 2 methodology requirements for a target/impact area. However, there is uncertainty about the quality of the 1999 investigation because UXO was found in 2008 in a portion of the AOC that had been reported as cleared in 1999. Materials found at the surface and subsurface at HG-01 consist of UXO (40 mm grenades and 40 mm projectiles), MD, 0.30 and 0.50 caliber projectiles, and a variety of non-munitions-related metal debris.

7.2.6.4 Nature and Extent of MC

No soil or other media samples were collected at HG-01 because there was no evidence of breached items that might be sources of MC.

7.2.7 JM-01

JM-01 is a candidate chemical weapons disposal area thought to be located in the Lake Jean area. Thirteen sites were evaluated and none was judged to be the actual location. The site was described by a WWII veteran (“J.M.”)

as a small, rectangular area enclosed by a barbed-wire fence that was used for a one-time chemical weapons disposal via earth-tamped detonation.

7.2.7.1 Investigation History

The investigation of JM-01 consisted of an extensive search to identify the location where chemical weapons were reportedly buried, based on an interview with J.M. The Navy brought J.M. to Adak in an effort to locate the site of the alleged disposal. J.M. identified areas east of Lake Jean that he believed were the sites of a storage bunker and the alleged disposal. Field staff members searched the potential Disposal Area with a Vallon metal detector. They noted positive hits for fallen fenceposts and remnants of a coal-burning camp stove. In 2001, the Navy sought other candidate sites for reconnaissance using 2001 low-altitude aerial photos, archive aerial photos, and archive maps. Thirteen candidate sites were selected for possible site reconnaissance. Analysis did not confirm any of the candidate sites and did not suggest any other likely locations for this disposal activity.

7.2.7.2 Nature and Extent of MEC

Because the site has not been located, no MEC investigations have been conducted.

7.2.7.3 AOC Type and Level 2 Methodology Status

Because the candidate disposal area has not been located, the Level 2 methodology requirements for a disposal area have not been met. JM-01 was designated as NOFA prior to the 2008 RI because it cannot be located and characterized.

7.2.7.4 Nature and Extent of MC

Because the site has not been located, no MC investigations have been conducted.

7.2.8 LJ-02A

LJ-02A is a possible disposal area located just south of Lake Jean within the Lake Jean Ammunition Complex. It is contained wholly within AOC LJ-02. This AOC was originally part of LJ-02 until potential evidence of buried items was found during the search for JM-01 in this area.

7.2.8.1 Investigation History

Previous investigations at LJ-02A consist of a 1999 ribbon-walk geophysical survey covering one transect through the site when it was part of LJ-02. This was followed by an EM-31 geophysical survey when LJ-02A was created in 2002 as a result of field observation (potential trench locations) made during the search for JM-01.

7.2.8.2 Nature and Extent of MEC

While no anomalies indicative of trenches were visible in the data, three point source anomalies were identified (Figure 7-7). All three of these targets were intrusively investigated and were found to be metal debris at depths between 0 and 1 foot bgs.

7.2.8.3 AOC Type and Level 2 Methodology Status

Based primarily on the findings of the 2002 geophysical survey, conditions at LJ-02A are not consistent with the identified AOC type (large scale burial/disposal area). However, all Level 2 methodology requirements for a large scale burial/disposal area have been fulfilled. LJ-02A was characterized as NOFA prior to the 2008 RI because the area had been fully investigated and only metal debris was found.

7.2.8.4 Nature and Extent of MC

No soil or other media samples were collected at LJ-02A because there was no evidence of breached items that might be sources of MC.

7.2.9 MAG-01

MAG-01 is believed to be the location of a storage magazine supporting two nearby gun emplacements. This AOC is located at the eastern end of the Andrew Lake seawall along the north-central shoreline of Adak Island.

7.2.9.1 Investigation History

No investigations were conducted at MAG-01 prior to 2008. However, a 2001 investigation of the nearby former gun emplacement encountered packing materials, including M-50/M-54 end caps and pieces of burned thermite residue, that may have been related to the former magazine.

The 2008 investigation was to consist of an instrument-aided visual inspection and site reconnaissance of 100 percent of the accessible portions of this AOC. However, the planned investigation in the southern portion of this AOC was modified by cutting 4-foot-wide paths, approximately 8 to 10 feet apart, through heavy vegetation and conducting the instrument-aided visual inspection along those paths. Approximately half of the southern area was covered by that investigation. Accessible areas (i.e., slopes of less than 30 degrees and areas not covered by water) in the northern portion of this AOC were fully swept as planned. Several large subsurface anomalies in the southern part of this AOC were determined to be cables and barrels. The majority of the debris was found adjacent to an overgrown road that runs north to south through the center of MAG-01.

7.2.9.2 Nature and Extent of MEC

Items found at the surface and subsurface at MAG-01 consisted only of non-munitions-related metal debris (Figure 7-8). No MEC items or evidence of the Storage Magazine were found.

7.2.9.3 AOC Type and Level 2 Methodology Status

Site use is not consistent with the AOC type (storage magazine).

The less-than-100-percent survey and intrusive investigation partially satisfy the Level 2 methodology requirements for a storage magazine, but no evidence of such storage remains, and no MEC items were found in MAG-01. Sufficient information has been gathered to make a determination about potential hazards and to evaluate potential remedies to address the hazards in the FS.

7.2.9.4 Nature and Extent of MC

No soil or other media samples were collected at MAG-01 because there was no evidence of breached items that might be sources of MC.

7.2.10 MI-01

MI-01 is located wholly within MI-03 and adjacent to MI-02 in the Range Complex at Andrew Lake (west of Andrew Lake). This AOC was initially classified as a target/impact area but was reclassified as a Disposal Area after the 1999 SI. However, due to the presence of numerous clustered UXO, the 2008 MEC investigation results appear to confirm the original target/impact area classification.

7.2.10.1 Investigation History

The 1999 investigation at MI-01 included a ribbon walk that covered a 1-meter-wide random pathway approximately 0.1 mile long. This was followed by intrusive investigation at six of 15 targets to a depth of 4 feet. Items found in 1999 included a single, fired, rifle grenade; six 3.5-inch practice rockets with live motors; a 2.36-inch practice rocket; and metal debris. All MEC items were found within 1 foot of the surface and were recovered and destroyed.

The 2008 investigation at MI-01 included a 100 percent geophysical survey and intrusive investigation to a depth of 2 feet at two 30-m by 30-m grids (Grids 5 and 6) centered on the earlier MEC finds and three step-out transects along the eastern side of Grid 6. A soil sample was also collected at a previously identified possible breached munitions location.

Items found in 2008 consisted primarily of UXO (2.36-inch and 3.5-inch rockets, 40 mm projectiles, and rifle grenades) and MD (rocket motors). MEC items were found on the boundaries of the grids. Step-out transects were used on the eastern side of Grid 6 to define the eastern limit of the target/impact area, but UXO (rockets and rifle grenades) were found in step-out transects X2 and X3, indicating the possible extension of the MI-03 target/impact area into MI-01. No MEC items were found along the western boundary of Grid 4 at MI-02, and steep slopes occur to the south. Therefore, the western and southern limits of the target/impact Area appear to have been defined. All MEC items were found within 1 foot of the surface and were recovered and destroyed.

7.2.10.2 Nature and Extent of MEC

Materials found at the surface and subsurface at MI-01 consist of UXO (2.36-inch and 3.5-inch rockets, 40 mm projectiles, and rifle grenades) and MPPEH (rocket motors). For the most part, UXO associated with the target/impact area is located within the AOC boundaries (Figure 7-9). However, rockets and rifle grenades were found in the northernmost step-out transect that extended beyond the eastern boundary of Grid 6 into MI-03, suggesting overlap of the several target/impact areas.

7.2.10.3 AOC Type and Level 2 Methodology Status

Conditions at MI-01 are not consistent with its identified AOC type (disposal area). The AOC appears to be a target/impact area. The work conducted to date only partially fulfills the Level 2 methodology requirements for a disposal area or a target/impact area because the area between and south of the two grids was not surveyed and intrusively investigated. However, sufficient information has been gathered to make a determination about potential hazards and to evaluate potential remedies to address the hazards in the FS.

7.2.10.4 Nature and Extent of MC

No MC was detected in the soil sample collected at the former location of a cluster of rockets, found during a previous investigation (Table 5-9). No additional breached items were identified in 2008. On the basis of these results, the soils at MI-01 do not appear to have been affected by release of MC.

7.2.11 MI-02

MI-02 is a target/impact area located along the southern side of the mortar impact valley in the Range Complex at Andrew Lake (west of Andrew Lake). It is bordered by MI-01 to the east and is otherwise surrounded by MI-03. Target munitions at MI-02 included 40 mm projectiles and 2.36-inch rockets.

7.2.11.1 Investigation History

The 1999 investigation at MI-02 included a ribbon walk that covered approximately 4.5 miles, as well as intrusive investigation of 78 targets (75 percent of those identified). UXO items, including 40 mm projectiles and 2.36-inch rockets, were found, along with frag and non-munitions-related metal debris.

The 2008 investigation included the following:

- A geophysical survey and intrusive investigation along 12 transects and in four 30-m by 30-m grids (Grids 1 through 4)
- Site reconnaissance for features indicative of erosion and instability
- Collection of a soil sample at a breached munitions location identified during the 1999 investigation
- Groundwater sampling for MC from two seeps along the valley wall

Only MD and non-munitions-related waste were identified in Grids 1 and 2. UXO items were found in both Grids 3 and 4, and along one transect. The UXO items in both grids were located along the grid boundary (north side of Grid 3, west side of Grid 4). Further delineation of MEC at Grid 4 was deferred to remedial action based on the proximity of Grid 5 in nearby MI-01. Delineation of MEC on the north side of Grid 3 was accomplished by extending Transects 16 and 17 in MI-03 to the boundary of the grid. No MEC items were found along Transects 16A and 17A. All MEC items found at MI-02 were removed and destroyed.

While steep and possibly unstable slopes are located within and adjacent to MI-02, these features are not located in the vicinity of high-density MEC, nor are they sufficiently large or suitably placed to cause erosion and migration of MEC to adjacent unaffected areas.

7.2.11.2 Nature and Extent of MEC

MEC found at MI-02 included 2.36- and 3.5-inch rockets, 40 mm projectiles, and mortars, as well as MPPEH and metal fragments. All items were found in the upper 2 feet of mineral soil. The abundance and type of MEC in areas outside 30-m by 30-m grids are assumed to be similar to those found in Grids 1 through 4.

The approximate extent of the target/impact Area was determined by DGM survey and intrusive investigation. It encompasses the portion of MI-02 where UXO and MPPEH were found (Figure 7-10). However, the boundaries of MI-02 with MI-01 and MI-03 are indistinct, and steep slopes along the northern and southern margins of this AOC limit possible refinement of the target/impact area.

7.2.11.3 AOC Type and Level 2 Methodology Status

Conditions at MI-02 are consistent with its identified AOC type (target/impact area). The work conducted to date fulfills the Level 2 methodology requirements for a target/impact area.

7.2.11.4 Nature and Extent of MC

No MC was detected in the soil sample collected at the former breached munition location identified during the 1999 investigation (Table 5-9). MC also was not detected in either of the two groundwater seep samples collected along the base of steep slopes in this AOC (Table 5-11). On the basis of these results, the soil and groundwater at MI-02 do not appear to have been affected by releases of MC.

7.2.12 MI-03

MI-03 is a large target/impact area that covers a steep valley draining west to east from the flanks of Mt. Moffett toward Andrew Lake. Two branches of Moffett Creek drain the upper portions of this AOC and combine to form the main channel of Moffett Creek near the center of MI-03. Target munitions at MI-03 included mortars, 40 mm projectiles, rockets, and rifle grenades.

7.2.12.1 Investigation History

Investigations at MI-03 began in 1992 with collection of surface water and sediment samples from Moffett Creek. The sample results were compared with risk-based concentrations and background values as part of a screening-level risk assessment conducted in 1996, and no COPCs were identified. The MC analytical results for the 1992 samples are listed and compared with the 2008 project screening levels in Tables 7-1 and 7-2.

The 1999 investigation included a ribbon walk that covered a 1-meter-wide random pathway approximately 16.7 miles long. This was followed by intrusive investigation at 220 of 402 targets to a depth of 4 feet. UXO (rifle grenade, 81 mm mortar, 40 mm projectiles, and 3.5-inch WP) and DMM (2.36-inch practice rockets), as well as numerous MPPEH and non-munitions-related metal debris items, were found during the investigation.

The 2008 investigation included geophysical surveys and intrusive investigations along numerous transects and in two grids (Grids 7 and 8). Only MD and non-munitions-related waste were identified in Grids 7 and 8. One UXO item (i.e., hand grenade) was found along a transect in the east-central portion of this AOC. The item was removed and destroyed. As indicated for MI-02, Transects 16 and 17 in MI-03 were extended to the northern boundary of Grid 3 to provide data for delineation of MEC found in that grid. No MEC was found. No evidence of MEC migration was found during the visual inspection of site features.

7.2.12.2 Nature and Extent of MEC

Materials found at the surface and subsurface at MI-03 consist of UXO (grenades, mortars, rifle grenades, rockets, and 40 mm projectiles), MD, and metal fragments. All MEC items were found within 2 feet of the surface and were removed and destroyed.

Table 7-1

Analytical Results for Sediment Samples Collected in 1992 - SWMU 1 Andrew Lake Range

Location ID				**SED-2**	**SED-4**	**SED-5**	**SG-1**	**SG-2**
Sample ID				21077	21079	21080	21076	21078
Sample Date				10/11/1992	10/11/1992	10/11/1992	10/11/1992	10/11/1992
Parameter Class	**Analyte Name**	**Units**	**PSL**					
Ordnance	1,3,5-TRINITROBENZENE	ug/kg	240	140 U	160 U	160 U	150 U	140 U
Ordnance	1,3-DINITROBENZENE	ug/kg	670	190 U	210 U	210 U	200 U	190 U
Ordnance	2,4,6-TRINITROTOLUENE	ug/kg	9200	65 U	74 U	73 U	68 U	65 U
Ordnance	2,4-DINITROTOLUENE	ug/kg	410000	38 U	43 U	42 U	39 U	38 U
Ordnance	2,6-DIAMINO-4-NITROTOLUENE	ug/kg	-	9.7 U	11 U	11 U	10 U	9.7 U
Ordnance	2,6-DINITROTOLUENE	ug/kg	200000	16 U	18 U	18 U	17 U	16 U
Ordnance	2-AMINO-4,6-DINITROTOLUENE	ug/kg	59000	9.7 U	11 U	11 U	10 U	9.7 U
Ordnance	4-AMINO-2,6-DINITROTOLUENE	ug/kg	-	9.7 U	**31 A**	11 U	10 U	9.7 U
Ordnance	HMX	ug/kg	470	9.7 U	11 U	11 U	10 U	9.7 U
Ordnance	NITROBENZENE	ug/kg	11000	170 U	200 U	190 U	180 U	170 U
Ordnance	PICRAMIC ACID	ug/kg	-	97 U	110 U	110 U	100 U	97 U
Ordnance	PICRIC ACID	ug/kg	-	97 U	110 U	110 U	100 U	97 U
Ordnance	PROPYLENE GLYCOL DINITRATE	ug/kg	-	35 U	39 U	39 U	36 U	35 U
Ordnance	RDX	ug/kg	80	170 U	200 U	190 U	180 U	170 U
Ordnance	TETRYL	ug/kg	820000	200 U	230 U	230 U	210 U	200 U

Notes:
- no value listed in MC QAPP
bold font indicates detected result
highlighting indicates exceedance of PSL

Qualifiers
A = Detected
J = Estimated
U = The analyte was analyzed for, but not detected.
R = rejected

Table 7-2

Analytical Results for Surface Water Samples Collected in 1992 - SWMU 1 Andrew Lake Range

Location ID				**SG-1**	**SG-2**	**SG-3**
Sample ID				21081	21082	21083
Sample Date				10/12/1992	10/12/1992	10/12/1992
Parameter Class	**Analyte Name**	**Units**	**PSL**			
Ordnance	1,3,5-TRINITROBENZENE	ug/L	120	--	0.2 U	0.2 U
Ordnance	1,3-DINITROBENZENE	ug/L	-	--	0.25 U	0.25 U
Ordnance	2,4,6-TRINITROTOLUENE	ug/L	14	--	0.09 U	0.09 U
Ordnance	2,4-DINITROTOLUENE	ug/L	-	--	0.02 U	0.02 U
Ordnance	2,6-DIAMINO-4-NITROTOLUENE	ug/L	-	0.2 U	0.2 U	0.2 U
Ordnance	2,6-DINITROTOLUENE	ug/L	-	--	0.01 U	0.01 U
Ordnance	2-AMINO-4,6-DINITROTOLUENE	ug/L	-	0.2 U	0.2 U	0.2 U
Ordnance	4-AMINO-2,6-DINITROTOLUENE	ug/L	-	0.2 U	0.2 U	0.2 U
Ordnance	HMX	ug/L	-	0.2 U	0.2 U	0.2 U
Ordnance	NITROBENZENE	ug/L	-	--	0.24 U	0.24 U
Ordnance	PROPYLENE GLYCOL DINITRATE	ug/L		--	0.05 U	0.05 U
Ordnance	RDX	ug/L	2360	0.2 U	0.24 U	0.24 U
Ordnance	TETRYL	ug/L	-	--	0.28 U	0.28 U
Ordnance	PICRAMIC ACID	ug/L	-	2.2 U	2.2 U	2.2 U
Ordnance	PICRIC ACID	ug/L	-	2 U	2 U	2 U

Notes:
- no value listed in MC QAPP
bold font indicates detected result
highlighting indicates exceedance of PSL

Qualifiers
A = detected
J = estimated
U = The analyte was analyzed for, but not detected.

The approximate extent of the target/impact area was determined by DGM survey and intrusive investigation. It encompasses the portion of MI-03 where UXO and MD were found (Figure 7-11). However, the internal boundaries with MI-01 and MI-02 are indistinct, and large swaths of steep terrain separate areas where MEC and MD were found.

While steep and possibly unstable slopes are located within and adjacent to MI-03, these features are not located in the vicinity of high-density MEC, nor are they sufficiently large or suitably placed to cause erosion and migration of MEC to adjacent unaffected areas.

7.2.12.3 AOC Type and Level 2 Methodology Status

Investigations conducted to date at MI-03 indicate site use consistent with the AOC type (target/impact area). The Level 2 methodology requirements for a target/impact area have been fulfilled.

7.2.12.4 Nature and Extent of MC

No MC was detected in the soil samples collected at the possible breached munition locations identified during a previous investigation (Table 5-9). No exceedances of project screening levels were identified in the surface water and sediment samples collected in 1992 (Tables 7-1 and 7-2). On the basis of these results, the environmental media at MI-03 do not appear to have been affected by releases of MC.

7.2.13 MM-10D

MM-10D is a small, square site on the eastern flanks of Mt. Moffett, where a lone, partial 81 mm mortar fragment was found.

7.2.13.1 Investigation History

Previous investigations at MM-10D consist of a 1999 ribbon-walk geophysical survey that covered 0.037 mile of ribbon walk to obtain one-dimensional geophysical data along a loop through the area. It was followed in 2000 by an additional 0.24 mile of geophysical mapping to perform the then-approved expansion-pattern investigation of the MD item found in 1999 (Figure 7-12). A single fragment of 81 mm mortar was found and removed in 1999; no additional items were found during the 2000 survey.

7.2.13.2 Nature and Extent of MEC

No MEC was found during the 1999 and 2000 investigations.

7.2.13.3 AOC Type and Level 2 Methodology Status

Based primarily on the findings of the 2000 geophysical survey, conditions at MM-10D are not consistent with the identified AOC type (target/impact Area). However, all Level 2 methodology requirements for a target/impact area have been fulfilled. MM-10D was characterized as NOFA prior to the 2008 RI because the area had been fully investigated and only the mortar fragment was found.

7.2.13.4 Nature and Extent of MC

No potential sources of MC were found at MM-10D and no samples were collected for MC analysis.

7.2.14 OB/OD-01

OB/OD-01 is a circular area encompassing visible historical demolition craters and an ample buffer zone around the craters to account for kick-outs during disposal operations.

7.2.14.1 Investigation History

Investigations at OB/OD-01 began in 1992 with collection of ten soil samples from historical operating and emergency burn pan locations. The sample results were compared with risk-based concentrations and background values as part of a screening-level risk assessment conducted in 1996, and several COPCs were identified. A subsequent, detailed risk assessment was conducted by URS in 1997 and found no unacceptable risks to hypothetical residential, recreational, or occupational use. A small area beneath the burn pan exceeded ecological benchmarks. The burn pan and associated soil were removed, and the excavated soil and other removed materials were characterized for disposal. The MC analytical results for the 1992 and 1996 samples are listed and compared with the 2008 project screening levels in Tables 7-3 and 7-4.

The 1999 investigation at OB/OD-01 consisted of 100 percent DGM surveys at multiple grids within this AOC. Selected targets in selected grids were intrusively investigated to provide representative data on the types and potential quantities of MEC items present in the area. A total of 38 percent of the targets were intrusively investigated. MEC was found within the upper 2 feet of soil and included M34 WP grenades, CADs, and discernible MPPEH (fuzes, rocket motors, and fins), as well as metal debris.

The 2008 investigation at OB/OD-01 included soil sampling for MC at three previously identified, possible breached munitions locations along the center axis of this AOC. An additional soil sample was collected at one of the locations for grain size analysis.

7.2.14.2 Nature and Extent of MEC

The approximate extent of OB/OD-01 is defined by the outermost extent of anomalies identified by the geophysical survey (Figure 7-13), which in many cases extend beyond the designated boundary of OB/OD-01. On the basis of items found in the limited intrusive investigations, MEC and MPPEH likely remain scattered at depths up to 2 feet throughout this AOC.

7.2.14.3 AOC Type and Level 2 Methodology Status

Site use consistent with AOC type (OB/OD Area).

The completed work at OB/OD-01 partially satisfies Level 2 methodology requirements for an OB/OD Area in that a 100 percent survey has been conducted, but only 38 percent of the anomalies were investigated. However, sufficient information has been gathered to make a determination about potential hazards and to evaluate potential remedies to address the hazards in the FS.

7.2.14.4 Nature and Extent of MC

MC was detected in the soil samples collected from this AOC in 1992. While the reported concentrations for two analytes (2,4-dinitrotoluene and 4-amino-2,6-dinitrotoluene) in two samples exceeded the current project screening levels (Table 7-3), the affected soils were removed. Analysis of soil taken from this AOC in 1996 did not detect those two constituents (Table 7-4).

Nitroglycerin was detected in one of three soil samples collected in this AOC during 2008 (Table 5-9). The detected concentration of nitroglycerin (0.52 mg/kg) was lower than the project screening level (0.61 mg/kg). Concentrations of all other target analytes in the sample were below detection limits. On the basis of these results, soils at OB/OD-01 do not appear to have been affected by releases of MC.

7.2.15 RG-01

RG-01 is a 40 mm grenade range located on a hillside northwest of the HG-01.

7.2.15.1 Investigation History

No formal investigations were conducted at RG-01 prior to 2006, due to the catastrophic hazard rating for 40 mm grenades. In 2006, an Engineering Evaluation/Cost Analysis and Action Memorandum were completed. These documents recommended 100 percent surface and subsurface removal of MEC and MD to a depth of 2 feet below the mineral soil surface or bedrock, whichever was encountered first, from the entire 16 acres (28 grids) of this AOC.

The NTCRA began in the 2006 field season with analog clearance of 19,002 surface and subsurface anomalies and identification of five additional expansion grids.

In 2008, analog clearance was conducted on the five expansion areas identified during 2006. In addition, clearance of additional expansion areas was conducted because 40 mm grenades were found. A 100 percent DGM survey of accessible areas was performed after completion of the analog clearances. During the DGM clearance,

Table 7-3

Analytical Results for Soil Samples Collected in 1992 - SWMU 1 Andrew Lake Range (Burn Pan Area)

Location ID				SS-10	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	SS-7
Sample ID				21075	21064	21065	21066	21067	21068	21069	21070	21071
Sample Date				10/13/1992	10/13/1992	10/13/1992	10/13/1992	10/13/1992	10/13/1992	10/13/1992	10/13/1992	10/13/1992
Parameter Class	**Analyte Name**	**Units**	**PSL**									
Ordnance	1,3,5-TRINITROBENZENE	ug/kg	180000	170 U	150 U	160 U	160 U	220 U	170 U	140 U	210 U	240 U
Ordnance	1,3-DINITROBENZENE	ug/kg	580	220 U	190 U	200 U	200 U	280 U	220 U	180 U	270 U	310 U
Ordnance	2,4,6-TRINITROTOLUENE	ug/kg	3600	75 U	67 U	70 U	70 U	98 U	75 U	62 U	94 U	110 U
Ordnance	2,4-DINITROTOLUENE	ug/kg	720	**3200 A**	39 U	41 U	41 U	57 U	43 U	36 U	54 U	62 U
Ordnance	2,6-DIAMINO-4-NITROTOLUENE	ug/kg	-	**17 A**	10 U	10 U	10 U	15 U	9.9 U	9.2 U	14 U	16 U
Ordnance	2,6-DINITROTOLUENE	ug/kg	730	**270 A**	16 U	17 U	17 U	24 U	18 U	15 U	23 U	26 U
Ordnance	2-AMINO-4,6-DINITROTOLUENE	ug/kg	83	11 U	10 U	10 U	10 U	15 U	9.9 U	9.2 U	14 U	16 U
Ordnance	4-AMINO-2,6-DINITROTOLUENE	ug/kg	75	11 U	10 U	**42 A**	10 U	15 U	9.9 U	9.2 U	14 U	**5300 A**
Ordnance	HMX	ug/kg	50000	11 U	10 U	**11 A**	10 U	15 U	9.9 U	9.2 U	14 U	16 U
Ordnance	NITROBENZENE	ug/kg	2000	200 U	180 U	190 U	190 U	260 U	200 U	160 U	250 U	290 U
Ordnance	PROPYLENE GLYCOL DINITRATE	ug/kg	-	40 U	36 U	38 U	38 U	52 U	40 U	33 U	50 U	57 U
Ordnance	RDX	ug/kg	4400	**110 J**	180 U	190 U	190 U	260 U	200 U	160 U	250 U	290 U
Ordnance	TETRYL	ug/kg	24000	230 U	210 U	220 U	220 U	300 U	230 U	190 U	290 U	330 U
Ordnance	PICRAMIC ACID	ug/kg	-	110 U	100 U	100 U	100 U	150 U	99 U	92 U	140 U	160 U
Ordnance	PICRIC ACID	ug/kg	-	110 U	100 U	100 U	100 U	150 U	99 U	92 U	140 U	160 U

Notes:
- no value listed in MC QAPP
bold font indicates detected result
highlighting indicates exceedance of PSL

Qualifiers
A = detected
J = estimated
U = The analyte was analyzed for, but not detected.

Table 7-3

Analytical Results for Soil Samples Collected in 1992 - SWMU 1 Andrew Lake Range

Location ID				**SS-8**		**SS-9**		**SS-9**	
Sample ID				21072		21073		21074	
Sample Date				10/13/1992		10/13/1992		10/13/1992	
Parameter Class	**Analyte Name**	**Units**	**PSL**						
Ordnance	1,3,5-TRINITROBENZENE	ug/kg	180000	120	U	190	U	240	U
Ordnance	1,3-DINITROBENZENE	ug/kg	580	160	U	250	U	320	U
Ordnance	2,4,6-TRINITROTOLUENE	ug/kg	3600	54	U	85	U	110	U
Ordnance	2,4-DINITROTOLUENE	ug/kg	720	**460**	**A**	49	U	63	U
Ordnance	2,6-DIAMINO-4-NITROTOLUENE	ug/kg	-	8.1	U	13	U	16	U
Ordnance	2,6-DINITROTOLUENE	ug/kg	730	**33**	**A**	21	U	27	U
Ordnance	2-AMINO-4,6-DINITROTOLUENE	ug/kg	83	8.1	U	**32**	**A**	**18**	**A**
Ordnance	4-AMINO-2,6-DINITROTOLUENE	ug/kg	75	**34**	**A**	13	U	16	U
Ordnance	HMX	ug/kg	50000	**21**	**A**	**160**	**A**	**110**	**A**
Ordnance	NITROBENZENE	ug/kg	2000	140	U	230	U	290	U
Ordnance	PROPYLENE GLYCOL DINITRATE	ug/kg	-	29	U	45	U	59	U
Ordnance	RDX	ug/kg	4400	140	U	**300**	**A**	**120**	**J**
Ordnance	TETRYL	ug/kg	24000	170	U	260	U	340	U
Ordnance	PICRAMIC ACID	ug/kg	-	81	U	130	U	160	U
Ordnance	PICRIC ACID	ug/kg	-	81	U	130	U	160	U

Notes:

- no value listed in MC QAPP

bold font indicates detected result

highlighting indicates exceedance of PSL

Qualifiers

A = detected

J = estimated

U = The analyte was analyzed for, but not detected.

TABLE 7-4

Results for Soil Bag in Drum Collected in 1996 - SWMU 1 Andrew Lake Range (Burn Pan Area)

Location ID				**SOIL BAG**
Sample ID				39467
Sample Date				7/15/1996

Parameter Class	**Analyte Name**	**Units**	**PSL**	
Ordnance	1,3,5-TRINITROBENZENE	mg/kg	180	1.37 U
Ordnance	1,3-DINITROBENZENE	mg/kg	0.58	2.74 U
Ordnance	2,4,6-TRINITROTOLUENE	mg/kg	3.6	2.13 U
Ordnance	2,4-DINITROTOLUENE	mg/kg	0.72	0.0939 U
Ordnance	2,6-DINITROTOLUENE	mg/kg	0.73	0.0939 U
Ordnance	2-AMINO-4,6-DINITROTOLUENE	mg/kg	0.083	0.0939 U
Ordnance	2-NITROTOLUENE	mg/kg	21	0.5 U
Ordnance	3-NITROTOLUENE	mg/kg	120	0.5 U
Ordnance	4-AMINO-2,6-DINITROTOLUENE	mg/kg	0.075	0.0939 U
Ordnance	4-NITROTOLUENE	mg/kg	-	0.5 UJ
Ordnance	HMX	mg/kg	50	1370 U
Ordnance	NITROBENZENE	mg/kg	2	13.7 U
Ordnance	PROPYLENE GLYCOL DINITRATE	mg/kg	-	0.11 UJ
Ordnance	RDX	mg/kg	4.4	0.581 U
Ordnance	TETRYL	mg/kg	24	0.274 U
Ordnance	PICRAMIC ACID	mg/kg	-	152.2 U
Ordnance	PICRIC ACID	mg/kg	-	228.1 UJ

Notes:
- no value listed in MC QAPP
bold font indicates detected result
highlighting indicates exceedance of PSL

Qualifiers
A = Detected
J = Estimated
U = The analyte was analyzed for, but not detected.

MEC was encountered near boundaries of four of the five grids and it was necessary to perform a step-out of the grids to maintain the 15-m buffer around MEC. All additional step-outs were first analog cleared and then DGM surveyed and cleared.

7.2.15.2 Nature and Extent of MEC

Items found in 2006 and 2008 consisted of a variety of UXO and MPPEH, including M433 40 mm HEDP grenades, M651 40 mm riot tear gas, M397 40 mm HE grenades, M716 40 mm smoke grenades, 60 mm mortar, 81 mm mortar, CAD, and M28 3.5 inch HEAT rocket. All MEC items were recovered and destroyed. MPPEH items included a projectile fuze, a bomb fuze, a 40 mm projectile, a CAD, and two 40 mm breached munitions. MPPEH items were vented and/or demilitarized by detonation. On the basis of observations by UXO personnel, the MPPEH items, rocket, and breached munitions were most likely “kick-outs” from the nearby former OB/OD area. The area was also used extensively for firing of small arms, up to and including .50 caliber weapons. Operations onsite were not able to locate or identify a traditional firing point for the 40 mm grenade launchers.

7.2.15.3 AOC Type and Level 2 Methodology Status

Site use consistent with AOC type (target/impact area).

All Level 2 methodology requirements for a target/impact area were fulfilled by the 2006 and 2008 NTCRA. All identified MEC were recovered and destroyed.

7.2.15.4 Nature and Extent of MC

Soil samples were collected at two locations where breached munitions were found during 2008. RDX and Octahydro-1, 3, 5, 7-tetranitro-1, 3, 5, 7-tetrazocine (HMX) were detected in the initial soil sample collected at one breached munitions location, and the RDX concentration was above the project screening level (Table 5-25). RDX was also detected in several follow-up samples taken at that location, but at concentrations below the project screening level (Table 5-25). Results of the 2008 sampling are further evaluated in the chemical risk assessment (Section 8).

7.2.16 RR-01

RR-01 is a target/impact area located in the southern central portion of the Andrew Lake Range Complex. Munitions fired at RR-01 included 37 mm projectiles, 40 mm HE projectiles and 2.36-inch rockets.

7.2.16.1 Investigation History

Investigations at RR-01 began in 1992 with collection of surface water and sediment samples from Moffett Creek. Another set of samples was collected in 1995. The sample results were compared with risk-based concentrations and background values as part of a screening-level risk assessment conducted in 1996, and no COPCs were identified. The MC analytical results for the 1992 and 1996 samples are listed and compared with the 2008 project screening levels in Tables 7-1, 7-2, and 7-5.

The 1999 investigation at RR-01 included a DGM survey of approximately 17.4 miles of transect (ribbon walk). It also included intrusive investigation of a portion (67 percent) of the targets identified in the north-central portion of the AOC, where a known-distance rifle range was located. MEC, as well as MPPEH and non-munitions-related metal debris, were identified in this AOC.

In 2008, DGM surveys and 100 percent intrusive investigations were conducted along a series of transects located outside the previously investigated area. An instrument-aided reconnaissance was performed in uninspected areas in the southern portion of this AOC. More than 900 targets along the transects were investigated, with multiple MEC and MPPEH finds and numerous MD, non-munitions-related metal debris, rock, and scrap finds. No evidence of possible MEC migration was found during the erosion/instability reconnaissance. A small amount of frag and small arms were found during the instrument-aided visual inspection, but no follow-up investigation was required. The 2008 investigation also included sediment sampling for MC at Moffett Creek.

Table 7-5
Analytical Results for Sediment Samples Collected in 1995 - SWMU 1 Andrew Lake Range

Location ID				**SED-6**	**SED-6**	**SED-7**	**SED-7**
Sample ID				25901	26125	25902	26126
Sample Date				7/14/1995	8/1/1995	7/14/1995	8/1/1995
Parameter Class	**Analyte Name**	**Units**	**PSL**				
Ordnance	1,3,5-TRINITROBENZENE	ug/g	0.24	0.25 R	0.25 U	0.25 R	0.25 U
Ordnance	1,3-DINITROBENZENE	ug/g	0.67	0.25 R	0.25 U	0.25 R	0.25 U
Ordnance	2,4,6-TRINITROTOLUENE	ug/g	9.2	0.25 R	0.25 U	0.25 R	0.25 U
Ordnance	2,4-DINITROTOLUENE	ug/g	410	0.25 R	0.25 U	0.25 R	0.25 U
Ordnance	2,6-DINITROTOLUENE	ug/g	200	0.26 R	0.26 U	0.26 R	0.26 U
Ordnance	2-AMINO-4,6-DINITROTOLUENE	ug/g	59	0.04 R	0.04 U	0.04 R	0.04 U
Ordnance	2-NITROTOLUENE	ug/g	25	0.25 R	0.25 U	0.25 R	0.25 U
Ordnance	3-NITROTOLUENE	ug/g	4100	0.25 R	0.25 U	0.25 R	0.25 U
Ordnance	4-AMINO-2,6-DINITROTOLUENE	ug/g	-	0.08 R	0.08 U	0.08 R	0.08 U
Ordnance	4-NITROTOLUENE	ug/g	360	0.25 R	0.25 U	0.25 R	0.25 U
Ordnance	HMX	ug/g	0.47	2.2 R	2.2 U	2.2 R	2.2 U
Ordnance	NITROBENZENE	ug/g	11	0.26 R	0.26 U	0.26 R	0.26 U
Ordnance	RDX	ug/g	0.08	1 R	1 U	1 R	1 U
Ordnance	TETRYL	ug/g	820	0.65 R	0.65 U	0.65 R	0.65 U

Notes:
- no value listed in MC QAPP
bold font indicates detected result
highlighting indicates exceedance of PSL

Qualifiers
A = detected
J = estimated
U = The analyte was analyzed for, but not detected.
R = rejected

7.2.16.2 Nature and Extent of MEC

Materials found at RR-01 consist of UXO (2.36-inch rockets and 40 mm projectiles), MPPEH, and metal fragments. Most UXO was found within 1 foot of the surface, and all identified targets have been cleared. The extent of the target/impact area has been bounded, and surface conditions in previously uninspected portions of this AOC south of the target/impact area are not indicative of possible impact outside that area. The distribution of MEC at RR-01 is shown in Figure 7-14.

While steep and possibly unstable slopes are located within and adjacent to RR-01, these features are not located in the vicinity of high-density MEC, nor are the features sufficiently large or suitably placed to cause erosion and migration of MEC to adjacent unaffected areas.

7.2.16.3 AOC Type and Level 2 Methodology Status

Investigations conducted to date at RR-01 indicate site use consistent with the AOC type (target/impact area). The completed work at RR-01 partially satisfies Level 2 methodology requirements for a target/impact area in that a 100 percent survey has been conducted, but only 67 percent of the anomalies in the former known-distance rifle range were investigated. However, sufficient information has been gathered to make a determination about potential hazards and to evaluate potential remedies to address the hazards in the FS.

7.2.16.4 Nature and Extent of MC

No exceedances of project screening levels were identified in the surface water and sediment samples collected in 1992 and 1995 (Tables 7-1 and 7-4). No MC was detected in the sediment samples collected in 2008 from the portion of the Moffett Creek stream bed that runs through this AOC (Table 5-10). On the basis of these results, as well as those from the earlier sampling events, the sediment and surface water at RR-01 does not appear to have been affected by releases of MC.

7.2.17 RR-02

RR-02 is the area located along the northern side of the valley containing the Range Complex at Andrew Lake. This AOC includes a valley running east-west that connects the flank of Mt. Moffett with the lowlands on the western shore of Andrew Lake. RR-02 was initially identified as a buffer for range areas, but it was reclassified as a possible target/impact area after the 1999 SI.

7.2.17.1 Investigation History

The 1999 investigation at RR-02 consisted of a ribbon walk (covering 7.5 miles) and intrusive investigation of all targets. MD (including an 81 mm HE tail boom, signal flares, an empty 60 mm mortar, and frag) was found in the area, suggesting that this AOC might have been a target/impact area rather than a range buffer zone (its original designation).

In 2008, RR-02 was investigated as a target/impact area based on the 1999 finds. The investigation consisted of the following:

- A geophysical survey and intrusive investigation of a series of transects, spaced at 25 m, in the uncharacterized accessible areas of the north-central portions of this AOC
- Instrument-aided visual inspection and site reconnaissance of the accessible northeastern, southwestern, and western portions of this AOC
- Collection of a soil sample where a cluster of items was found during the 1999 investigation

A variety of MD items and non-munitions-related metal debris was found, but no MEC items were identified along the transects. MD was also observed in the southwestern uninvestigated area. Four geophysical transects were surveyed through the area and no targets were identified for intrusive investigation.

7.2.17.2 Nature and Extent of MEC

Materials found at RR-02 consist mostly of a variety of MD and non-munitions-related metal debris, most likely carried over from adjacent ranges (Figure 7-15). No MEC items were found in this AOC, and surface conditions in previously uninspected portions of this AOC are not consistent with those of a target/impact area.

7.2.17.3 AOC Type and Level 2 Methodology Status

Investigations conducted to date at RR-02 indicate site use consistent with the initial AOC type (range buffer zone) rather than the adjusted AOC type (target/impact area) presented in the RI Work Plan. However, all Level 2 methodology requirements for a target/impact Area have been fulfilled.

7.2.17.4 Nature and Extent of MC

No MC was detected in the soil sample collected at the former location of a cluster of items found in the northern tip of this AOC during a previous investigation (Table 5-9). On the basis of these results, the soils at RR-02 do not appear to have been affected by releases of MC.

7.2.18 RR-03

RR-03 is a small, square site located near the southeastern boundary of the historical Range Complex at Andrew Lake. It is wholly within AOC RR-04 and was created to allow evaluation of a lone, abandoned, signal flare found in 1999.

7.2.18.1 Investigation History

Previous investigation at RR-03 consisted of a ribbon walk in 1999 that covered a 1-m-wide random pathway approximately .006 mile long (one pass across the 30-m-square site). A single, abandoned, signal flare was found. In 2000, an additional 1.01 miles of transect were walked to obtain 100 percent geophysical coverage of accessible portions of the site, followed by intrusive investigation of 39 targets (100 percent of those identified) to 4 feet bgs (Figure 7-16). Most anomalies were determined to be non-munitions-related metal debris; only a possible 2.36-inch rocket with no fuze and the signal flare were found and destroyed.

7.2.18.2 Nature and Extent of MEC

The approximate extent of the MEC-affected area has been determined and all anomalies have been investigated. All MEC items were found within 2 feet of the surface and were recovered and destroyed.

7.2.18.3 AOC Type and Level 2 Methodology Status

Site use is not consistent with AOC type (target/impact area). However, all Level 2 methodology requirements for a target/impact area have been fulfilled. RR-03 was characterized as NOFA prior to the 2008 RI because this AOC had been fully investigated and only the two items and metal debris were found.

7.2.18.4 Nature and Extent of MC

No potential sources of MC were found at RR-03 and no samples were collected for MC analysis.

7.2.19 RR-04

RR-04 is a range buffer area that encompasses most of the lower valley at the former Andrew Lake Range Complex.

7.2.19.1 Investigation History

In 1992, sediment and surface water samples were collected from the mouth of Moffett Creek at the outflow to Andrew Lake just east of the boundary of RR-04. The sample results were compared with risk-based concentrations and background values as part of a screening-level risk assessment conducted in 1996. No COPCs were identified. The analytical results for the samples are listed in Tables 7-1 and 7-2.

The 1999 investigation at RR-04 consisted of a ribbon walk that covered 12 miles and intrusive investigation of 82 percent of targets. Only non-munitions-related metal debris was found.

The 2008 investigation included the following:

- Geophysical and intrusive investigation of two transects in areas where previous data did not meet the Level 2 spacing required by the combat range model adopted for this AOC (since none exists for a Range Buffer Zone).
- Instrument-aided visual inspection and site reconnaissance of the accessible areas of the southwest corner of this AOC
- Collection of sediment, surface water, and groundwater samples

7.2.19.2 Nature and Extent of MEC

Materials found at the surface and subsurface at RR-04 consisted of metals fragments and a variety of metal debris associated with use of this AOC as a support area for nearby ranges (Figure 7-17). No MEC was found. In 2008, a partially full container (55-gallon drum) of tar or similar viscous petroleum product was found along the transect in the eastern portions of this AOC. The material in the drum appeared to be too thick to seep out of the container and the soil around the drum was not stained, so the drum was left in place at the direction of the NTR. The drum and its contents will be addressed during the OU B-2 remedial action.

7.2.19.3 AOC Type and Level 2 Methodology Status

Investigations conducted to date at RR-04 indicate site use consistent with the AOC type (range buffer zone). Because there is no specific Level 2 methodology for range buffer zone, combat range methodology was applied and fulfilled.

7.2.19.4 Nature and Extent of MC

Samples of sediment, surface water, and groundwater were collected within the boundaries of RR-04. No MC was detected in any of the environmental media samples collected in this AOC (Tables 5-10 through 5-12). On the basis of these results, the environmental media at RR-04 do not appear to have been affected by MC. Because RR-04 is located between potential MC release locations (i.e., ranges) and Andrew Lake, these data also indicate that Andrew Lake is unlikely to have been affected by MC releases from the range areas.

7.2.20 SA-01

SA-01 is a small arms range located at the northern edge of the former Range Complex at Andrew Lake (on the west side of the lake).

7.2.20.1 Investigation History

The 1999 investigation at SA-01 was limited to field reconnaissance during the PSE and incidental encroachment during the 1999 SI, which reported the presence of a small arms range.

The 2008 investigation consisted of a 100 percent geophysical survey and intrusive investigation of one 30-m by 30-m grid centered on the area where the buried small arms munitions were previously discovered. It also included instrument-aided inspection and site reconnaissance of remaining accessible portions of this AOC. No MEC was found in the grid or in the areas observed during the instrument-aided reconnaissance. Materials found at the surface and subsurface at SA-01 consist of small-caliber projectiles and non-munitions-related metal debris.

7.2.20.2 Nature and Extent of MEC

The potential burial area at SA-01 was fully surveyed and intrusively investigated, and the remainder of the AOC was evaluated for possible MEC using instrument-aided reconnaissance techniques. No MEC was found (Figure 7-18).

7.2.20.3 AOC Type and Level 2 Methodology Status

The investigation found site use consistent with the AOC type (small arms range). Because there is no specific Level 2 methodology for a small arms range, the target/impact area methodology was applied and fulfilled.

7.2.20.4 Nature and Extent of MC

No potential sources of MC were found at SA-01 and no samples were collected for MC analysis.

7.2.21 SA93-01

SA93-01 is a target/impact area located on a plateau northeast of Andrew Lake. Munitions fired in the area included 2.36-inch rockets, 37 mm projectiles, 37 mm HE projectiles, 57 mm HE projectiles, 75 mm HE projectiles, and 81 mm mortars.

7.2.21.1 Investigation History

The 1999 investigation at SA93-01 included a DGM survey over approximately 12.5 miles of transect (ribbon walk) and intrusive investigation of 181 targets (100 percent). Finds included 2.36-inch rockets, 37-, 57-, and 75-mm projectiles, and mortars, as well as MPPEH and non-munitions-related metal debris.

The 2008 investigation at SA93-01 consisted of geophysical surveys and intrusive investigations at numerous transects and at one 30-m by 30-m grid (Grid 13). It also included reconnaissance for evidence of erosion features and accessibility along the eastern and western boundaries of this AOC. Soil samples were also collected at two previously identified possible breached munitions locations, and surface water and sediment samples were collected in the unnamed creek that drains SA93-01.

MEC found at SA93-01 in 2008 included rockets, mortars, and projectiles, the majority of which was encountered within the upper 12 inches of mineral soil. UXO was also found within and along the eastern boundary of Grid 13, but step-out transects to the east were not surveyed because of steep terrain and similarity of finds in nearby Grid 14 at SA93-03. All MEC items found along transects and the grid were removed and destroyed. No features indicative of erosion and site instability that could be a factor for potential migration of MEC beyond AOC boundaries were identified during the reconnaissance effort. Steep slopes were found in the previously uninvestigated areas along the eastern and western boundaries.

7.2.21.2 Nature and Extent of MEC

Multiple mortars, projectiles, and rockets were found along a northwest/southeast alignment crossing through this AOC, as shown in Figure 7-19. The approximate extent of this Target/Impact Area has been defined, although the eastern boundary with SA93-02 is indistinct because of steep terrain. On the basis of MEC results for SA93-03, located just east of Grid 13, the impact area appears to extend from SA93-03, across an intervening ravine, and into SA93-01.

7.2.21.3 AOC Type and Level 2 Methodology Status

Items found in SA93-01 were consistent with use of the area as a target/impact area. The Level 2 methodology requirements for the AOC type have been fulfilled.

7.2.21.4 Nature and Extent of MC

No MC was detected in the soil, sediment, or surface water samples (Tables 5-10 and 5-12). On the basis of these results, the environmental media at SA93-01 do not appear to have been affected by releases of MC within SA93-01.

7.2.22 SA93-02

SA93-02 is a long, narrow strip of land running along the eastern edge of SA93-01. This AOC was identified initially as a target/impact area, but it was reclassified as a potential storage area after the 1999 SI.

7.2.22.1 Investigation History

The 1999 investigation at SA93-02 consisted of a ribbon walk that covered 4.1 miles and intrusive investigation of 70 targets (97 percent). Only metal debris, much of which was domestic in origin (auto parts, nuts, and bolts), was found.

SA93-02 was investigated in 2008 as a possible storage area based on the 1999 finds. The 2008 investigation included the following:

- Instrument-aided visual inspection and site reconnaissance of the accessible portions of this AOC
- Visual inspection of site features indicative of erosion and site instability that could be a factor for potential migration of MEC beyond AOC boundaries
- Collection of co-located sediment and surface water samples from the Mitchell Creek drainage channel at the southern end of this AOC.

The instrument-aided inspection and site reconnaissance found only an artillery-lifting lug and an expended M48 series fuze; there was no evidence of impact or detonations (Figure 7-20).

7.2.22.2 Nature and Extent of MEC

No MEC items were found at SA93-02.

7.2.22.3 AOC Type and Level 2 Methodology Status

Inspection of SA93-02 found little evidence that this AOC was either a target/impact area (initial AOC type) for munitions or a storage area (adjusted AOC type). However, all Level 2 methodology requirements for a storage area have been fulfilled. Note, the uninvestigated ravine between SA93-01 and SA93-03 may be part of that target/impact area.

7.2.22.4 Nature and Extent of MC

No MC was detected in the sediment and surface water samples collected downstream of this AOC (Tables 5-10 and 5-12). On the basis of these results, Mitchell Creek at SA93-02 does not appear to have been affected by releases of MC.

7.2.23 SA93-03

SA93-03 is located wholly within SA93-02 near the southern boundary of that AOC. It was believed initially that SA93-03 was the principal firing point for 2.36-inch rockets found within SA93-01 (located across the ravine to the west). This AOC was reclassified as a target/impact area for 2.36-inch rockets after the 1999 SI.

7.2.23.1 Investigation History

The 1999 investigation at SA93-03 included a 0.1-mile-long ribbon walk that covered a 1-m-wide random pathway, as well as intrusive investigation of nine targets (100 percent). Five 2.36-inch rockets and one 2.36-inch rocket motor were found in the area.

The 2008 investigation included a geophysical survey and intrusive investigation at a grid (Grid 14) that occupied the entire accessible portion of this AOC. MEC found within and along the boundaries of the grid included 2.36-inch rockets, most of which were encountered within the upper 1 foot of mineral soil (1 item was found at 1 to 2 feet bgs). UXO items were found along the eastern and southern edges of Grid 13, and step-out transects were used to delineate the extent of MEC along these boundaries. Additional delineation of MEC on the west side of the grid (where a steep ravine is present) was deferred to remedial action because of terrain, as well as similarities in MEC occurrence between SA93-01 and SA93-03. No MEC items were found in the step-out transects on the eastern and southern sides of Grid 14. The 2008 investigation also included soil sampling for MC at a previously identified possible breached munitions location.

7.2.23.2 Nature and Extent of MEC

Materials found at SA93-03 consist of 2.36-inch rockets, as well as MPPEH and MD associated with impact. Most UXO items were encountered within 1 foot of the surface. The extent of MEC to the north, east, and south has been defined. However, the boundary with SA93-02 and SA93-01 along the western edge of Grid 14 is indistinct (Figure 7-21).

7.2.23.3 AOC Type and Level 2 Methodology Status

Items found in SA93-03 were consistent with use of this AOC as a target/impact area, with MEC found along a northwest/southeast alignment crossing through this AOC into SA93-01 to the west. The Level 2 methodology requirements for target/impact area have been fulfilled.

7.2.23.4 Nature and Extent of MC

No MC was detected in the soil sample collected in 2008 (Table 5-9). On the basis of these results, the soils at SA93-03 do not appear to have been affected by releases of MC.

7.2.24 SA93-04

SA93-04 consists of a small area, located on the eastern border of SA93-02, that was identified initially as a target/impact Area but was reclassified as a potential storage area after the 1999 SI.

7.2.24.1 Investigation History

The 1999 investigation at SA93-04 consisted of a ribbon walk that covered approximately 100 feet, as well as intrusive investigation. The survey found a trash pile containing metal banding, metal crates, and a lid from an ordnance crate that originally contained 155-mm projectiles.

In 2008, the area was investigated as a possible storage area, with an instrument-aided inspection and site reconnaissance of the accessible portions of this AOC to identify potential evidence of burial or disposal. Only MD was found. The site reconnaissance found no MEC items or evidence of impact or detonations.

7.2.24.2 Nature and Extent of MEC

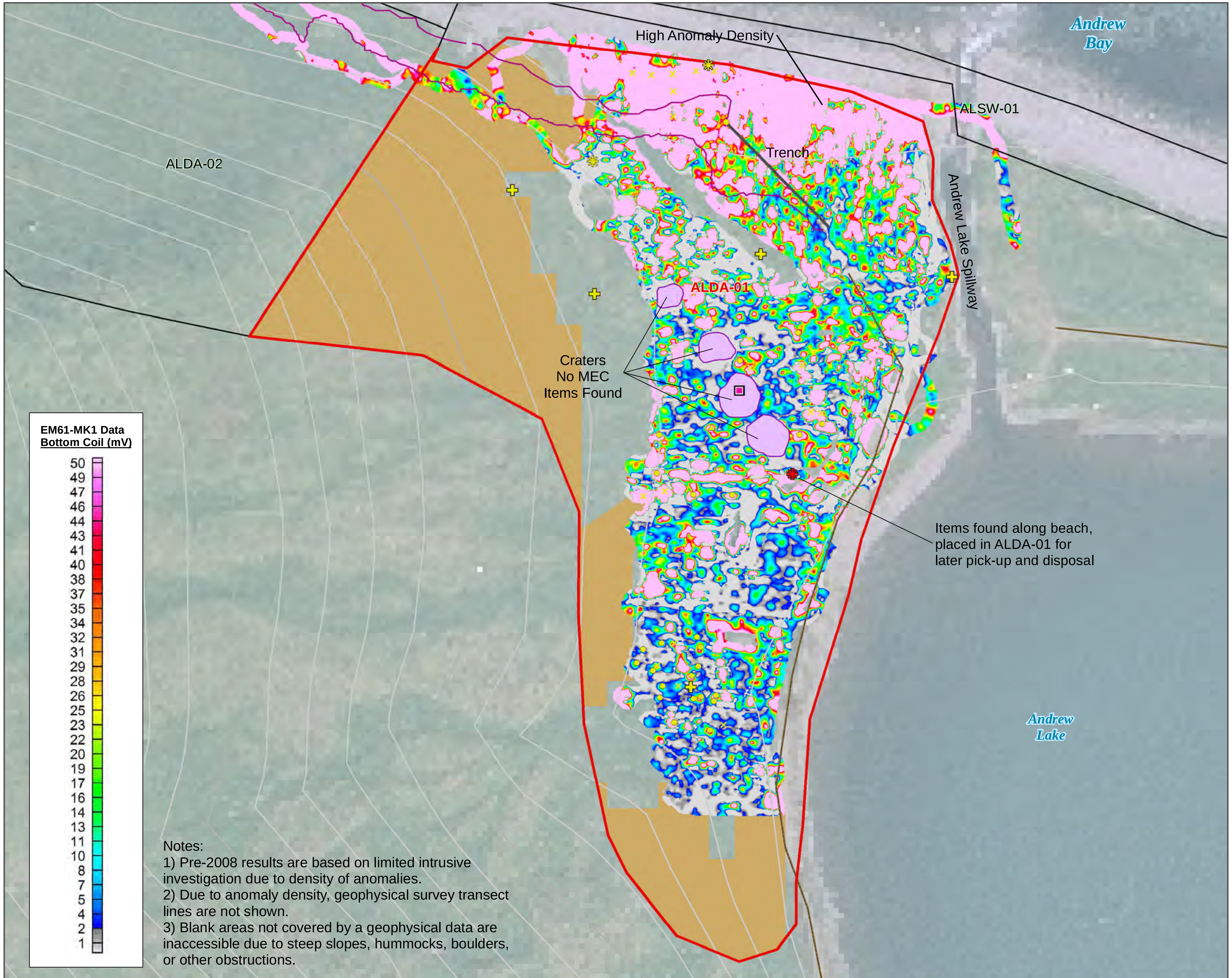
No MEC items were found.

7.2.24.3 AOC Type and Level 2 Methodology Status

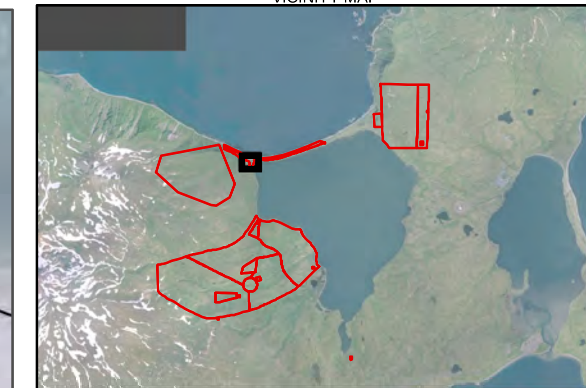
On the basis of the 1999 and 2008 findings (Figure 7-22), the site use does not appear to be consistent with either the initial AOC type (target/impact area) or the adjusted AOC type (potential storage area). However, all Level 2 methodology requirements for a storage area have been fulfilled.

7.2.24.4 Nature and Extent of MC

No potential sources of MC were found at SA93-04 and no samples were collected for MC analysis.



VICINITY MAP



MEC Investigation
- 2008 Unexploded Ordnance (UXO)
- Pre-2008 Unexploded Ordnance (UXO)
- 2008 Discarded Military Munitions (DMM)
- Pre-2008 Discarded Military Munitions (DMM)
- Pre-2008 Material Presenting Potential Explosive Hazard (MPPEH)
- Pre-2008 Munitions Debris (MD)
- Pre-2008 Other (not munitions-related material)
- ALSW-01 West Recon Transect
- Instrument Aided Visual Reconnaissance

MC Investigation
- 2008 Soil Sample

Topography and Site Features
- Subject AOC
- AOC
- Slopes Greater Than 30 Degrees (As calculated from terrain model)
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

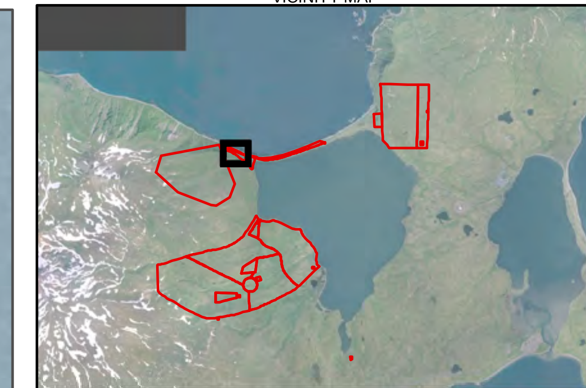
0 65 130
Feet

N

FIGURE 7-1
ALDA-01 Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska

CH2MHILL

VICINITY MAP



MEC Investigation
ALSW-01 West Recon Transect
Instrument Aided Visual Reconnaissance

MC Investigation
2008 Sediment Sample

Topography and Site Features
Subject AOC
AOC
Slopes Greater Than 30 Degrees (As calculated from terrain model)
500-ft Contour
100-ft Contour
20-ft Contour
Road
Stream
Standing Water

Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

0 105 210
Feet

N

FIGURE 7-2
ALDA-02 Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska

SEA \\JAFAR\PROJ\ADAK_335753\MAPFILES\RIFS_2011\NATUREANDEXTENT_MAPBOOK.MXD RGRABARE 4/11/12 3:02:40 PM

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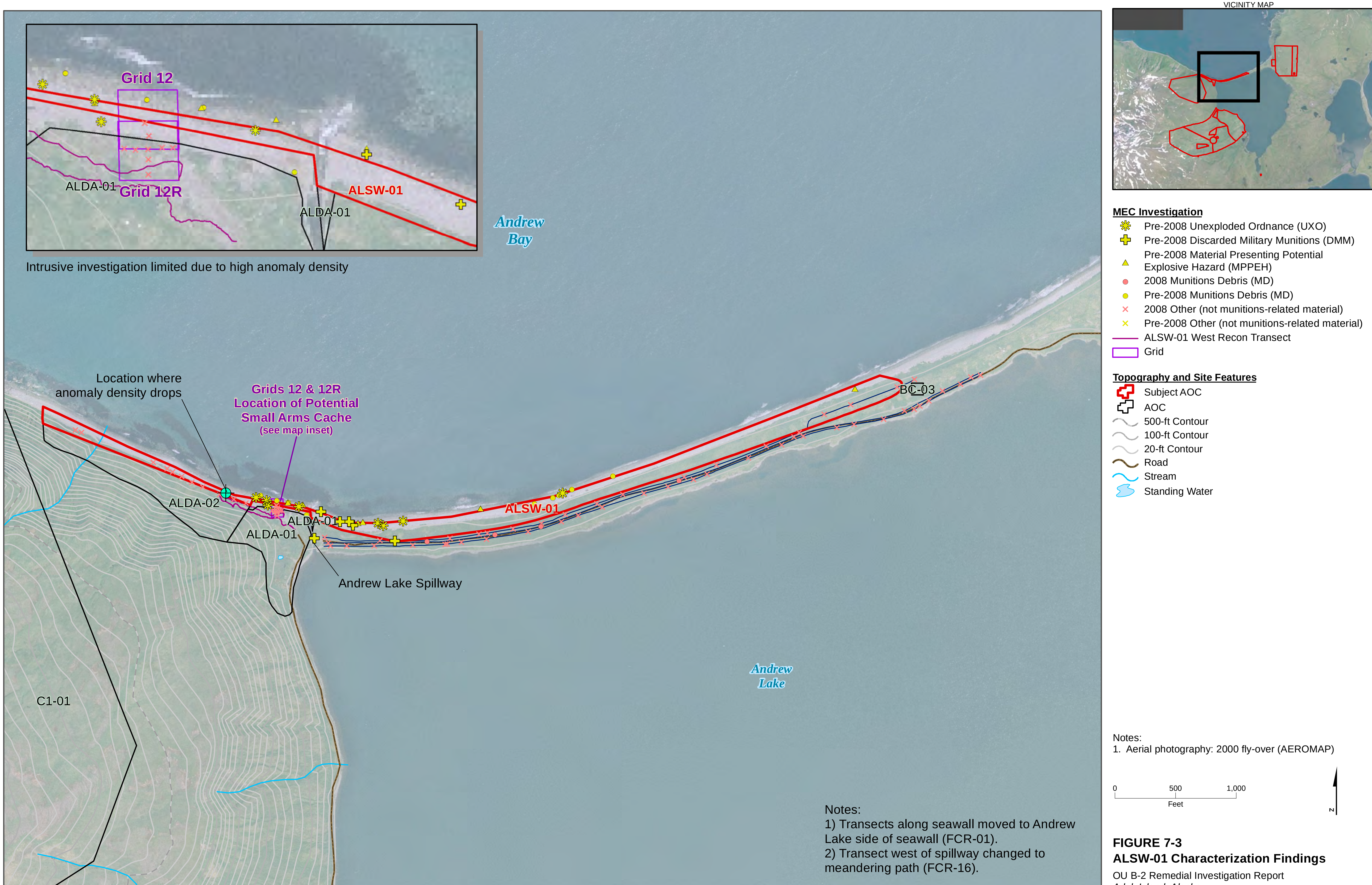

MEC Investigation

- Pre-2008 Unexploded Ordnance (UXO)
- Pre-2008 Discarded Military Munitions (DMM)
- Pre-2008 Material Presenting Potential Explosive Hazard (MPPEH)
- 2008 Munitions Debris (MD)
- Pre-2008 Munitions Debris (MD)
- 2008 Other (not munitions-related material)
- Pre-2008 Other (not munitions-related material)
- ALSW-01 West Recon Transect
- Grid

Topography and Site Features

- Subject AOC
- AOC
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

0 500 1,000
Feet

N

FIGURE 7-3
ALSW-01 Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska

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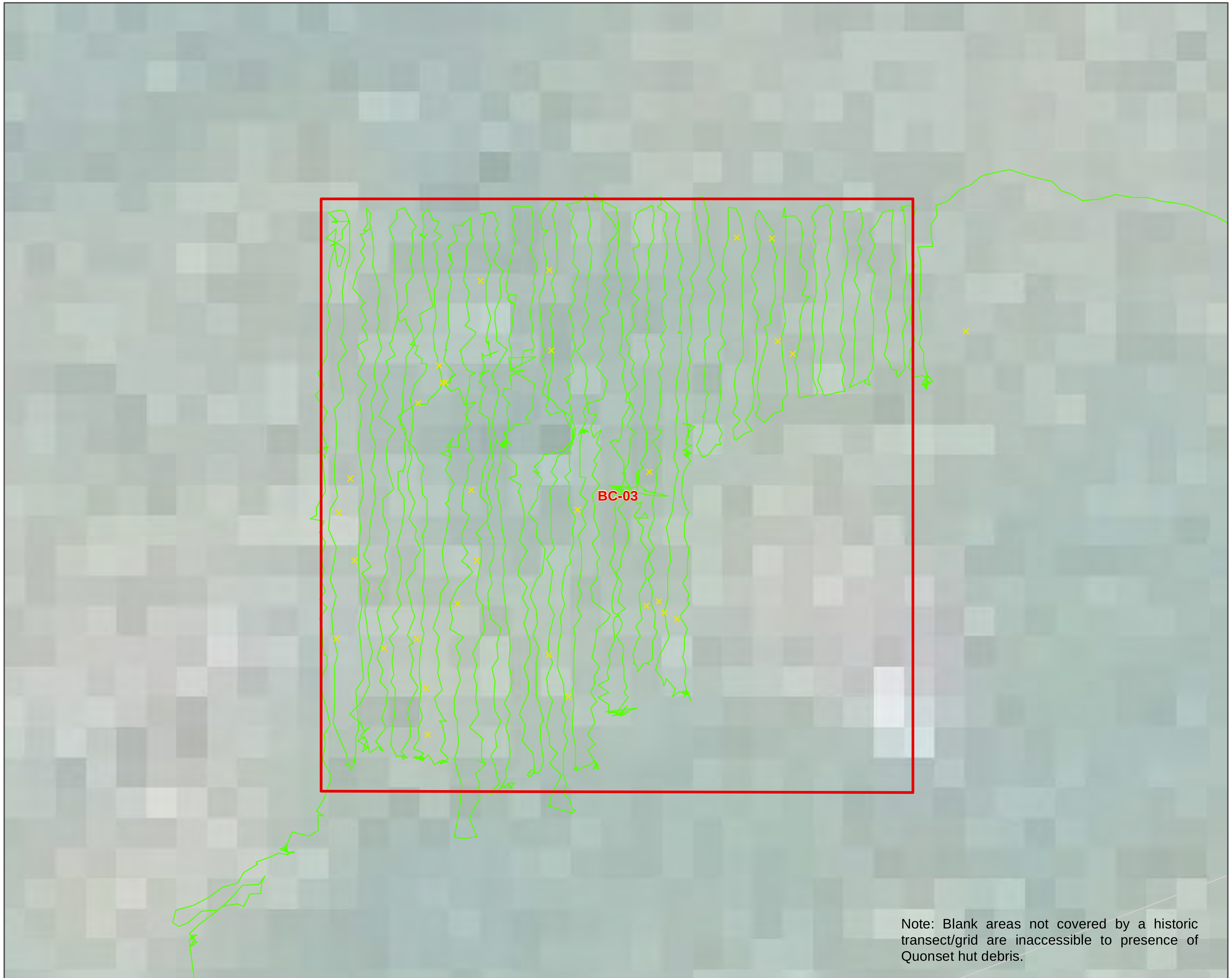
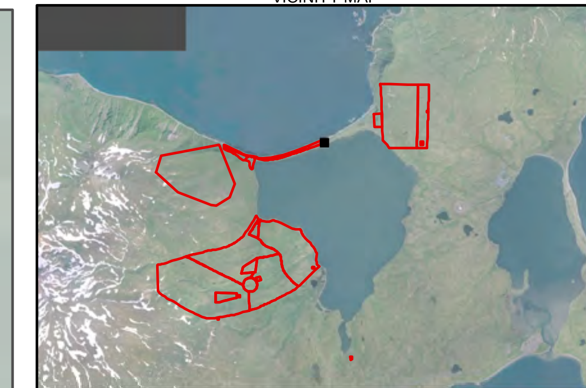


VICINITY MAP



MEC Investigation

- Pre-2008 Other (not munitions-related material)
- Pre-2008 Geophysical Survey Transect

Topography and Site Features

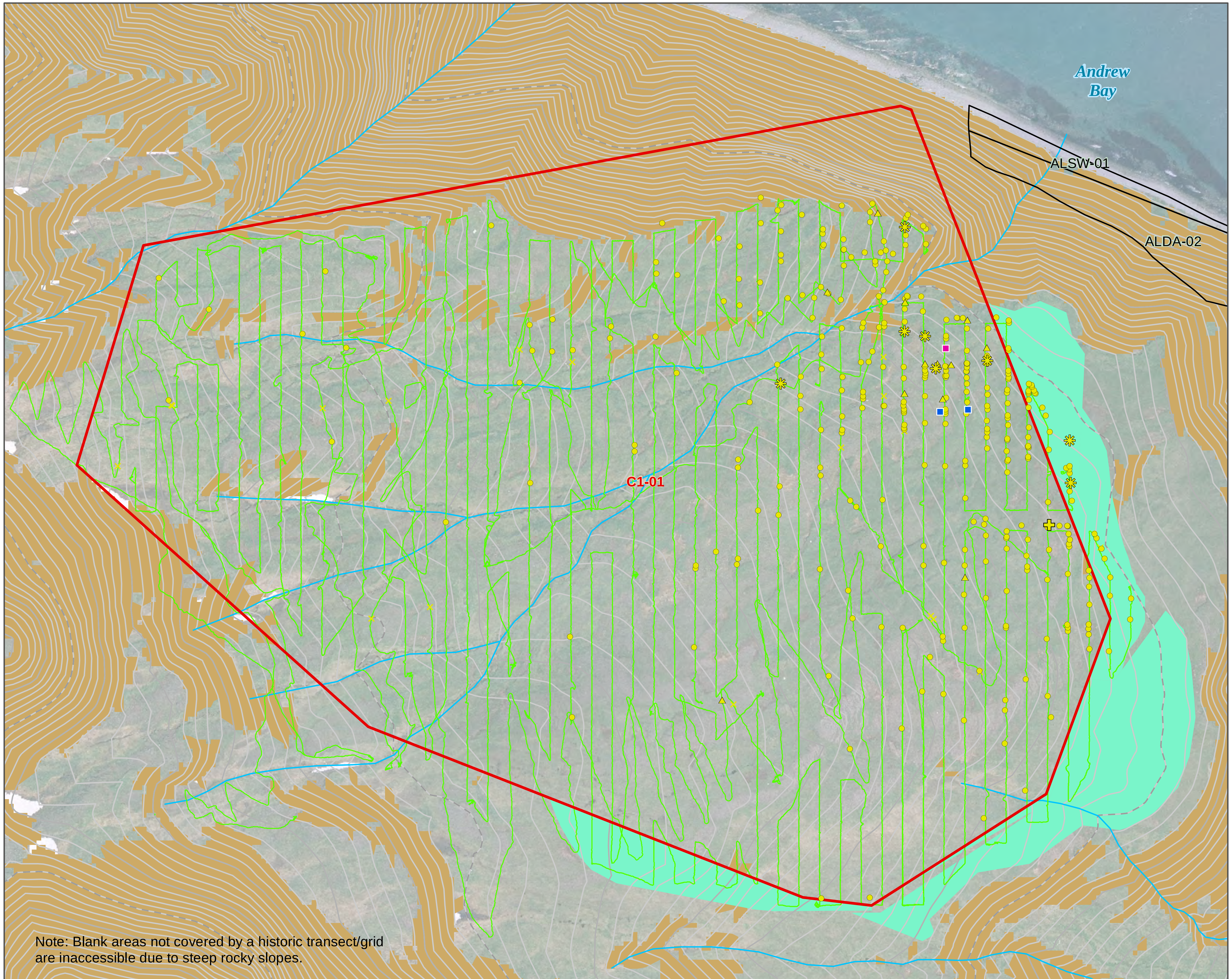
- Subject AOC
- AOC
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

0 10 20
Feet

N

FIGURE 7-4
BC-03 Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska



MEC Investigation

- Pre-2008 Unexploded Ordnance (UXO)
- Pre-2008 Discarded Military Munitions (DMM)
- Pre-2008 Material Presenting Potential Explosive Hazard (MPPEH)
- Pre-2008 Munitions Debris (MD)
- Pre-2008 Other (not munitions-related material)
- Pre-2008 Geophysical Survey Transect
- Accessibility Survey Area, Slopes Greater Than 30 Degrees

MC Investigation

- 2008 Sediment Sample
- Pre-2008 Soil Sample

Topography and Site Features

- Subject AOC
- AOC
- Slopes Greater Than 30 Degrees (As calculated from terrain model)
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

0 385 770
Feet

N

FIGURE 7-5
C1-01 Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska

CH2MHILL

MEC Investigation

- 2008 Unexploded Ordnance (UXO)
- Pre-2008 Unexploded Ordnance (UXO)
- Pre-2008 Material Presenting Potential Explosive Hazard (MPPEH)
- 2008 Munitions Debris (MD)
- Pre-2008 Munitions Debris (MD)
- 2008 Other (not munitions-related material)
- Pre-2008 Other (not munitions-related material)
- Pre-2008 Geophysical Survey Transect
- Grid

Topography and Site Features

- Subject AOC
- AOC
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

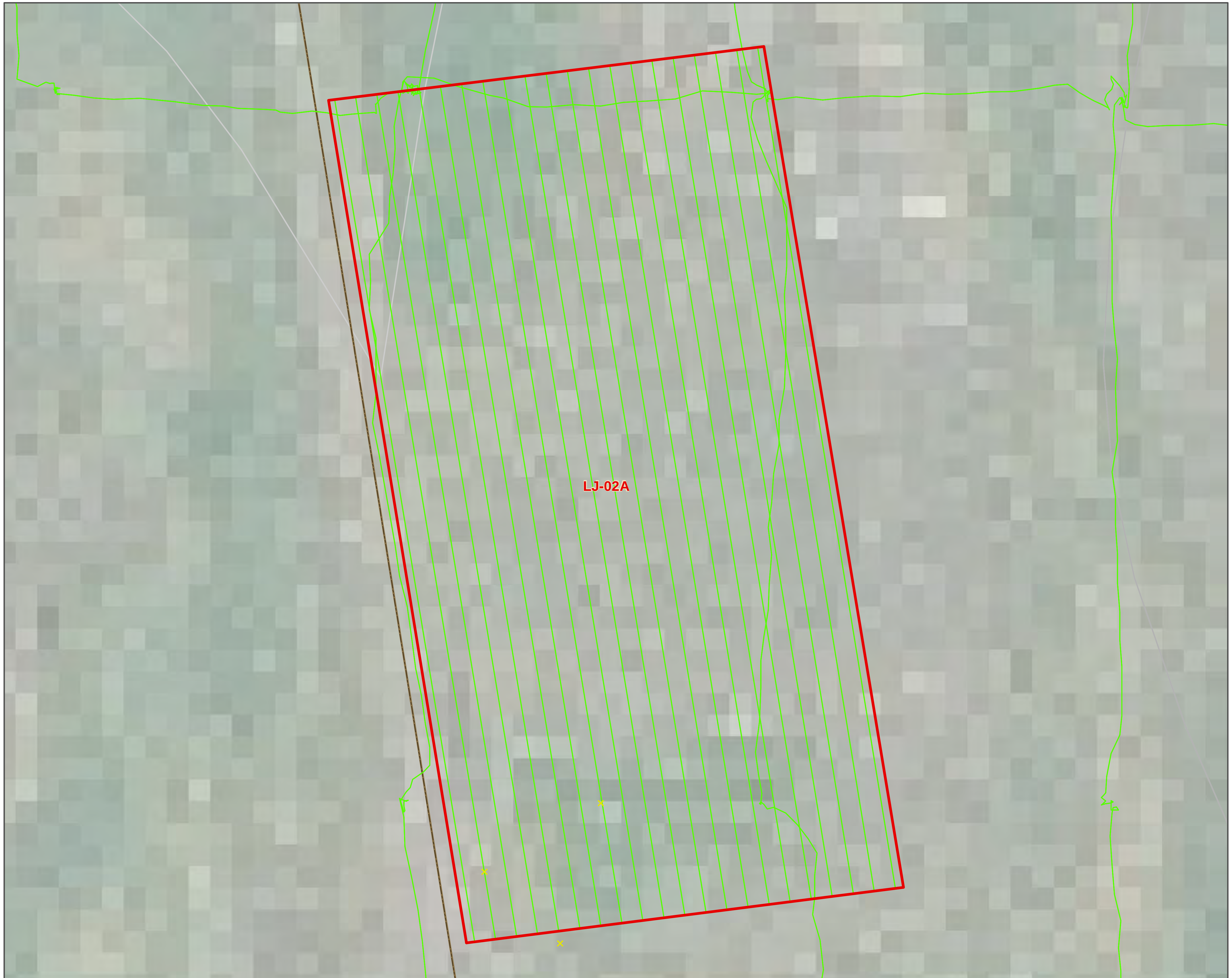
Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

0 35 70
Feet

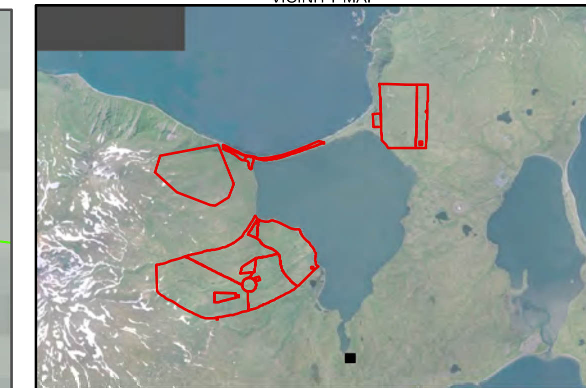
N

FIGURE 7-6
HG-01 Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska

CH2MHILL



VICINITY MAP



MEC Investigation

- Pre-2008 Other (not munitions-related material)
- Pre-2008 Geophysical Survey Transect

Topography and Site Features

- Subject AOC
- AOC
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

0 15 30
Feet

N

FIGURE 7-7
LJ-02A Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska

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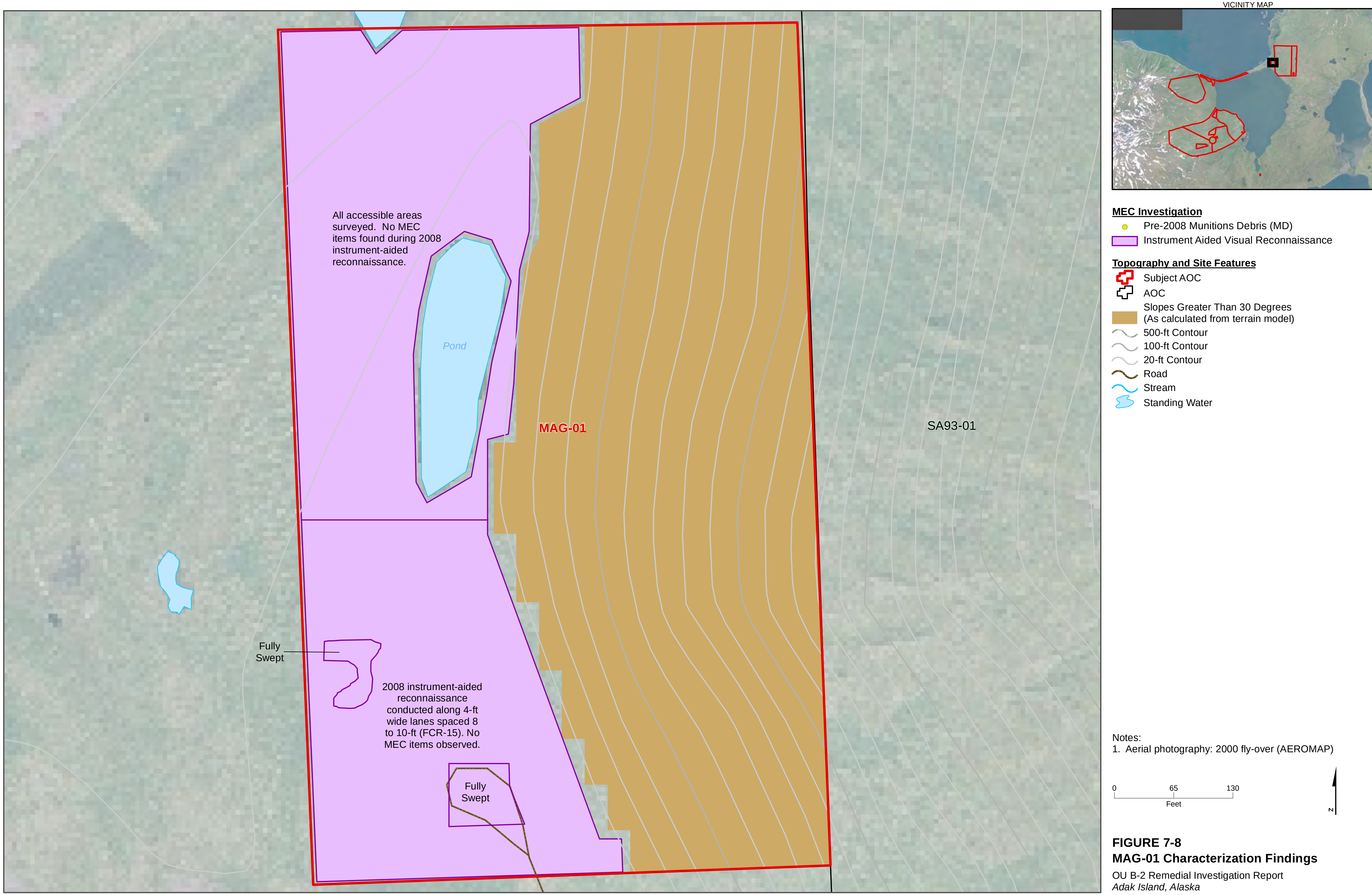

Notes:
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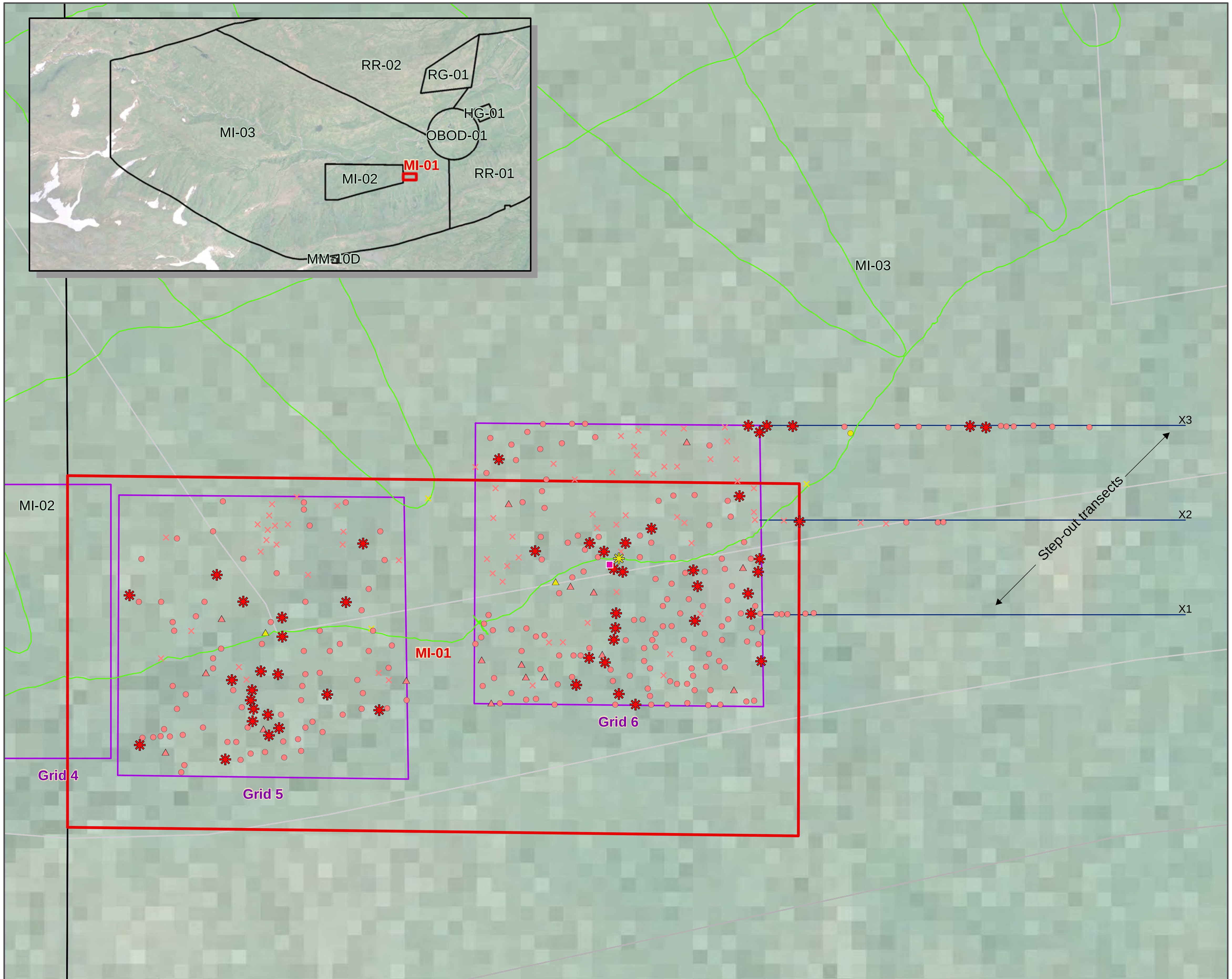
FIGURE 7-8
MAG-01 Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska



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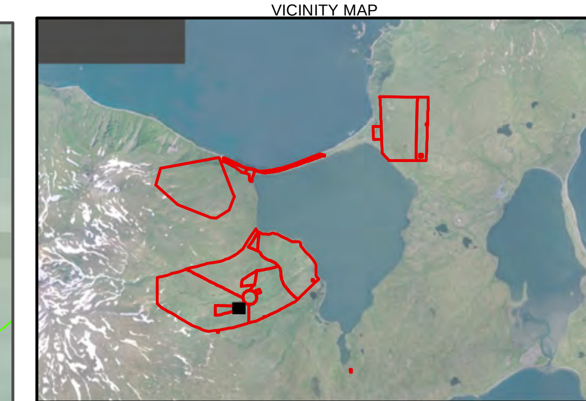

MEC Investigation

- 2008 Unexploded Ordnance (UXO)
- Pre-2008 Unexploded Ordnance (UXO)
- 2008 Material Presenting Potential Explosive Hazard (MPPEH)
- Pre-2008 Material Presenting Potential Explosive Hazard (MPPEH)
- 2008 Munitions Debris (MD)
- Pre-2008 Munitions Debris (MD)
- 2008 Other (not munitions-related material)
- Pre-2008 Other (not munitions-related material)
- 2008 Geophysical Survey Transect
- Pre-2008 Geophysical Survey Transect
- Grid

MC Investigation

- 2008 Soil Sample

Topography and Site Features

- Subject AOC
- AOC
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

0 20 40
Feet

N

FIGURE 7-9
MI-01 Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska

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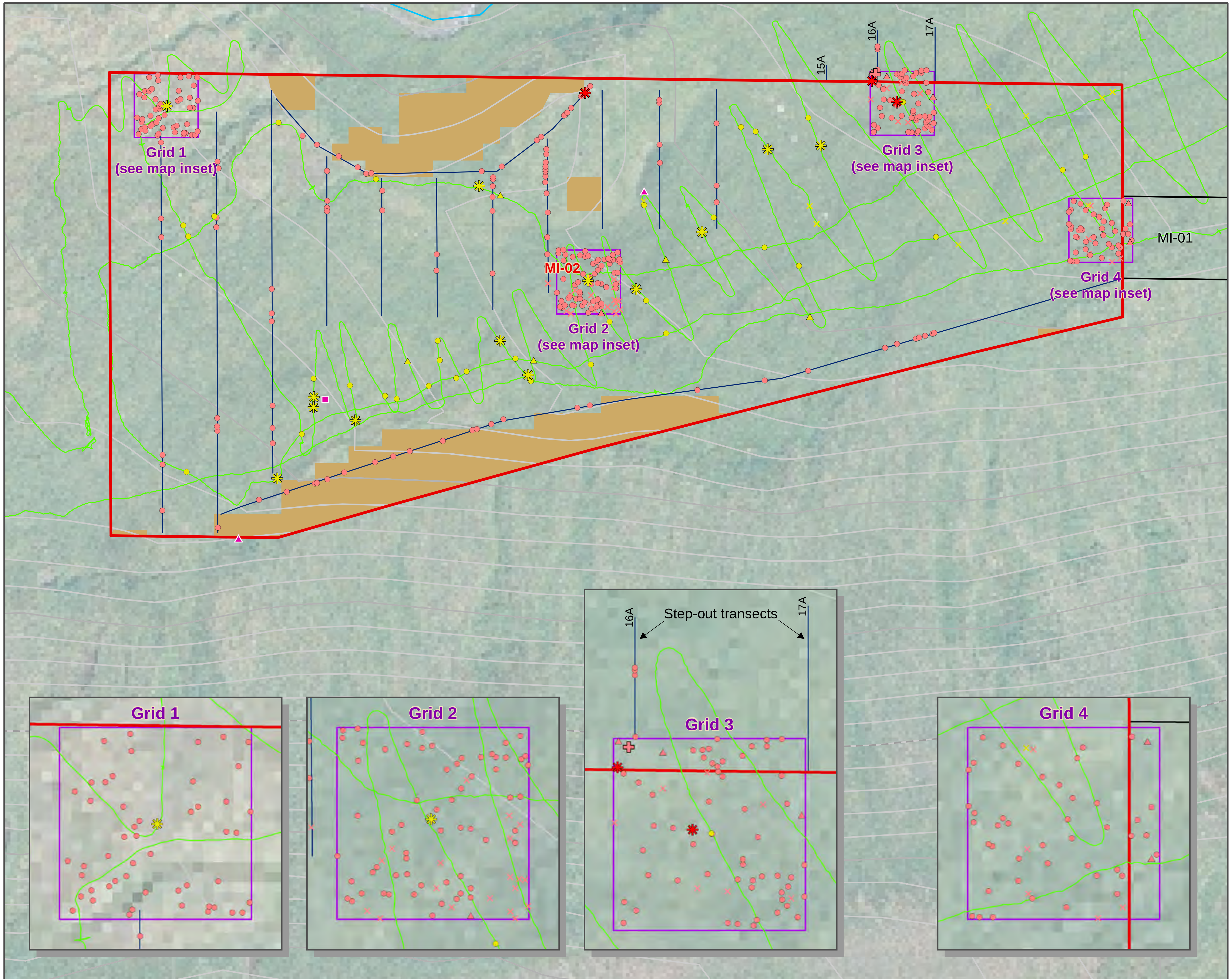
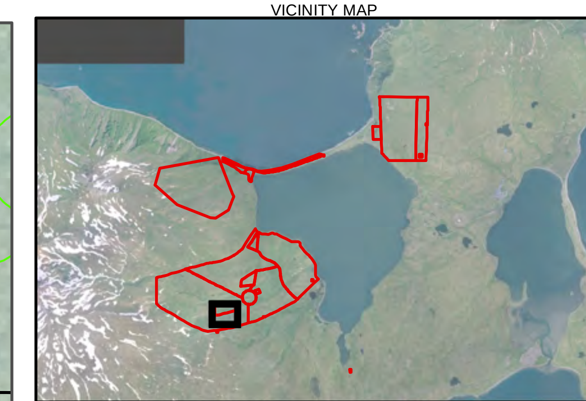
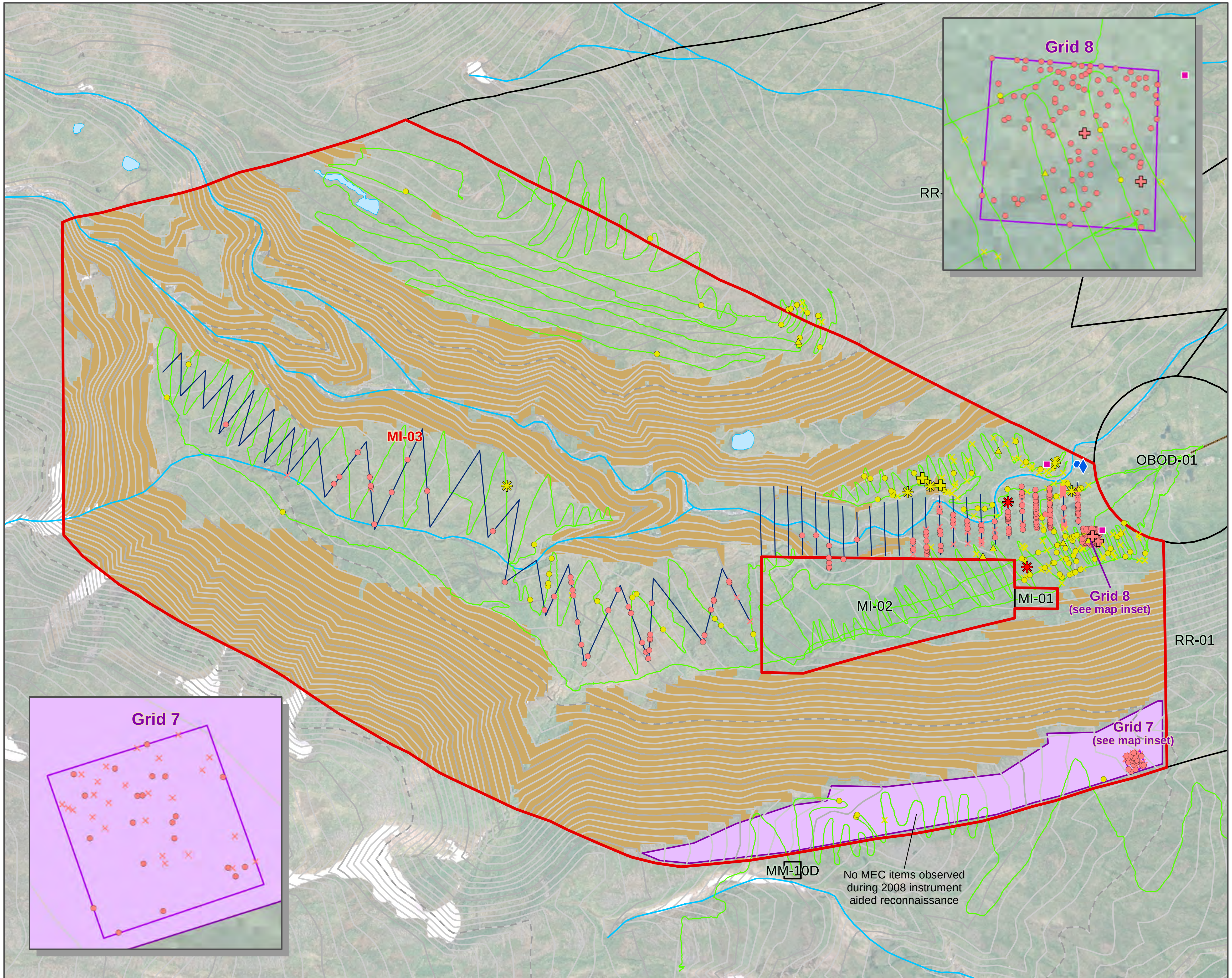




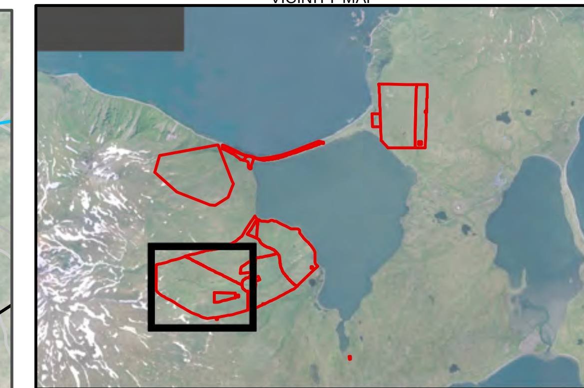
Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

FIGURE 7-10
MI-02 Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska

CH2MHILL



VICINITY MAP



MEC Investigation

- 2008 Unexploded Ordnance (UXO)
- Pre-2008 Unexploded Ordnance (UXO)
- 2008 Discarded Military Munitions (DMM)
- Pre-2008 Discarded Military Munitions (DMM)
- Pre-2008 Material Presenting Potential Explosive Hazard (MPPEH)
- 2008 Munitions Debris (MD)
- Pre-2008 Munitions Debris (MD)
- 2008 Other (not munitions-related material)
- Pre-2008 Other (not munitions-related material)
- 2008 Geophysical Survey Transect
- Pre-2008 Geophysical Survey Transect
- Grid
- Instrument Aided Visual Reconnaissance

MC Investigation

- 2008 Groundwater Sample
- Pre-2008 Surface Water Sample
- Pre-2008 Sediment Sample

Topography and Site Features

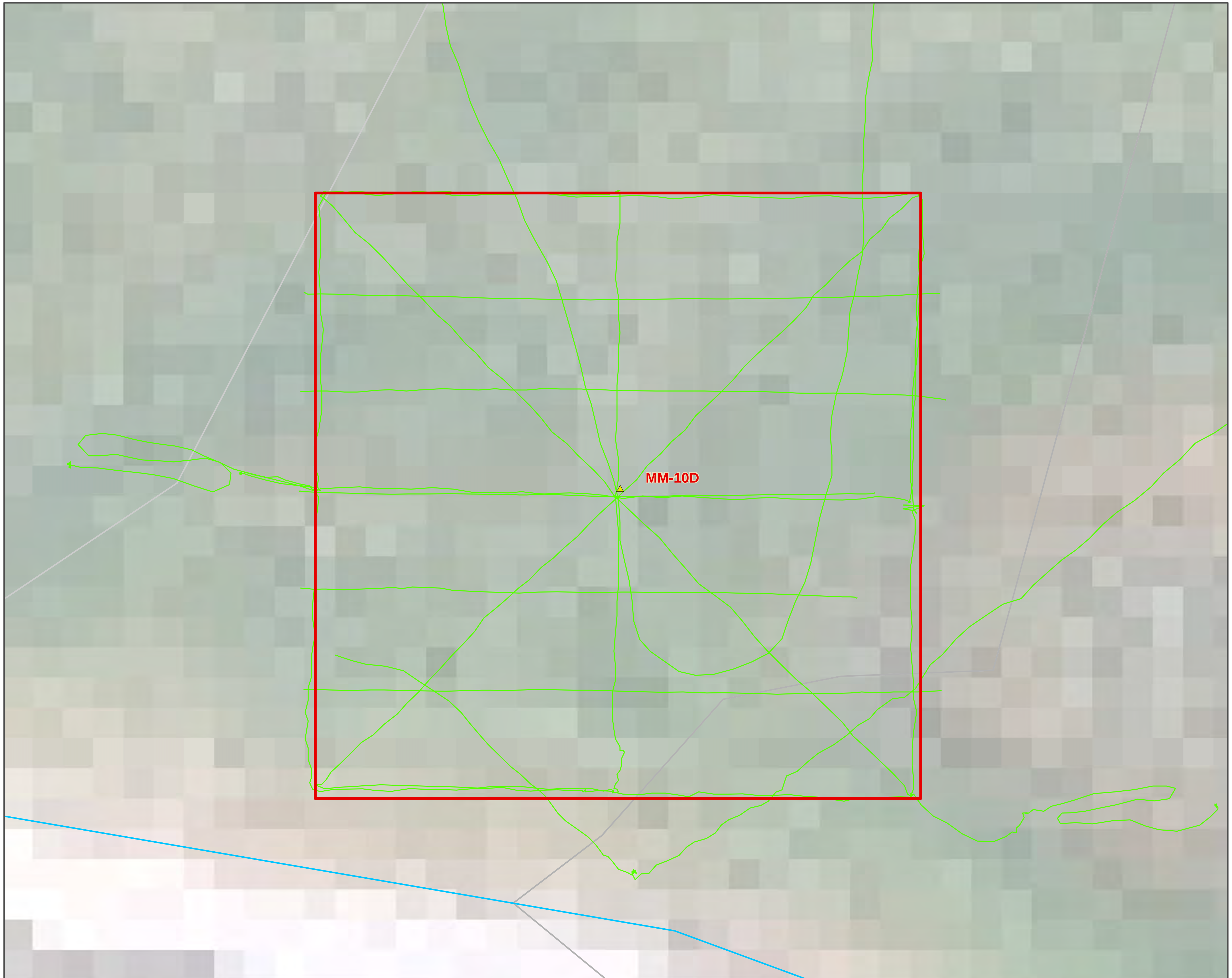
- Subject AOC
- AOC
- Slopes Greater Than 30 Degrees (As calculated from terrain model)
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

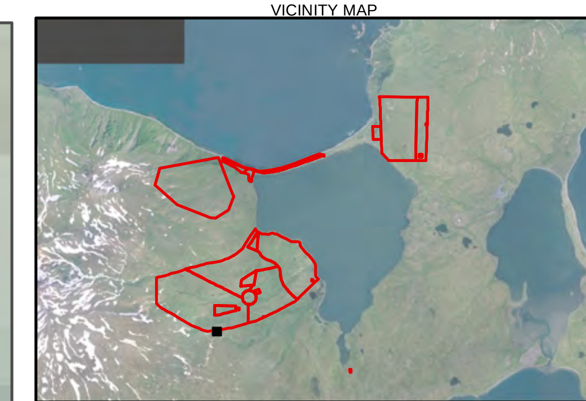
Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

0 420 840
Feet

N

FIGURE 7-11
MI-03 Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska





MEC Investigation

- Pre-2008 Material Presenting Potential Explosive Hazard (MPPEH)
- Pre-2008 Geophysical Survey Transect

Topography and Site Features

- Subject AOC
- AOC
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

0 10 20
Feet

N

FIGURE 7-12
MM-10D Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska

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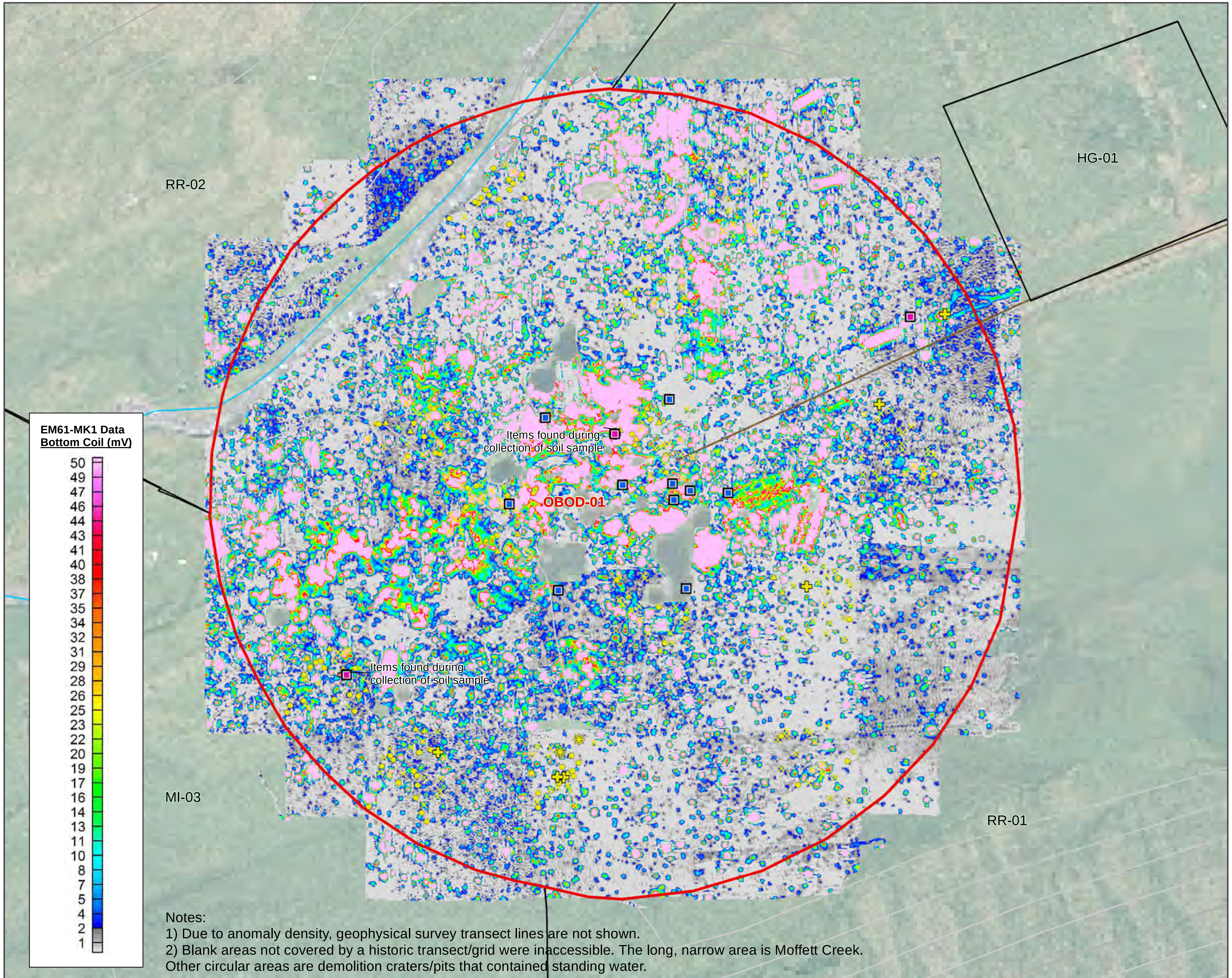

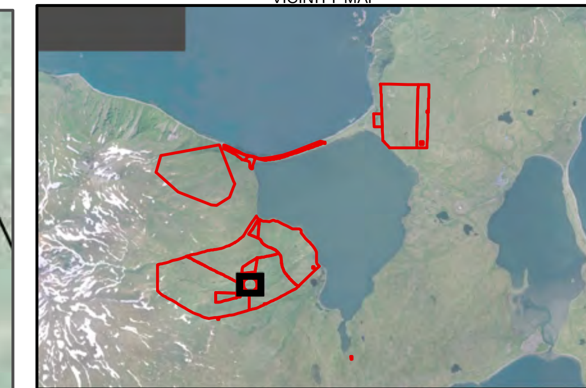

MEC Investigation

- Pre-2008 Unexploded Ordnance (UXO)
- 2008 Discarded Military Munitions (DMM)
- Pre-2008 Discarded Military Munitions (DMM)
- Pre-2008 Material Presenting Potential Explosive Hazard (MPPEH)
- Pre-2008 Munitions Debris (MD)
- Pre-2008 Other (not munitions-related material)

MC Investigation

- 2008 Soil Sample
- Pre-2008 Soil Sample

Topography and Site Features

- Subject AOC
- AOC
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

0 85 170
Feet

N

FIGURE 7-13
OB/OD-01 Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska

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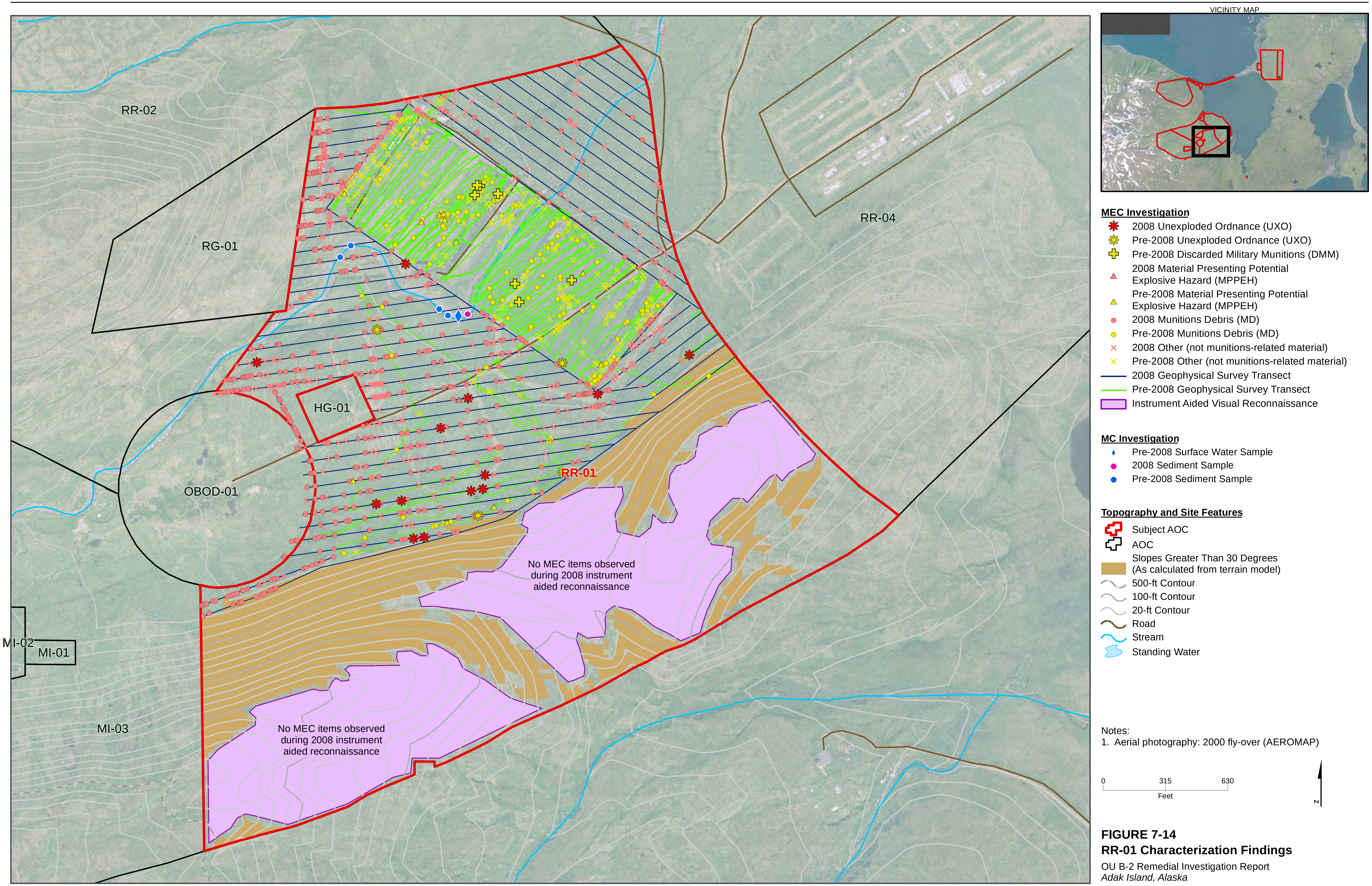

FIGURE 7-14
RR-01 Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska

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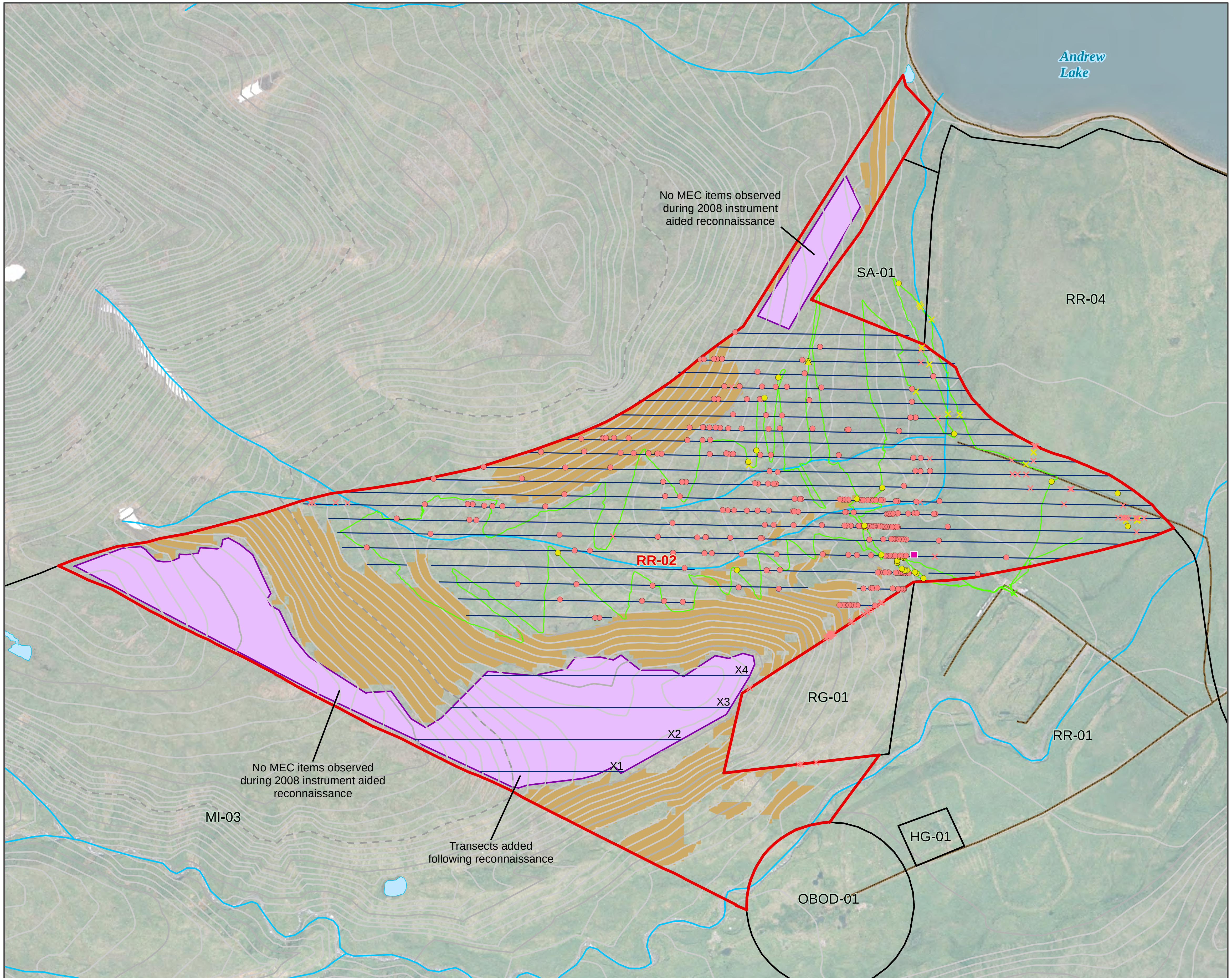
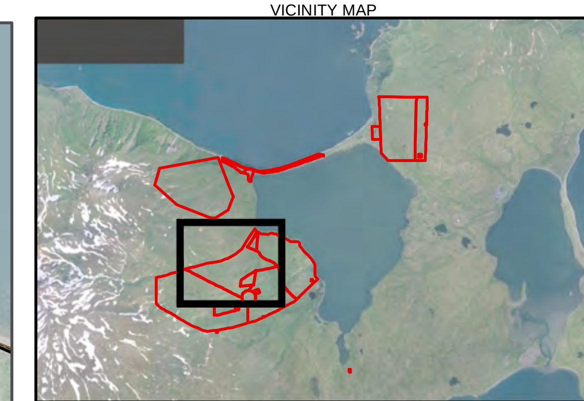
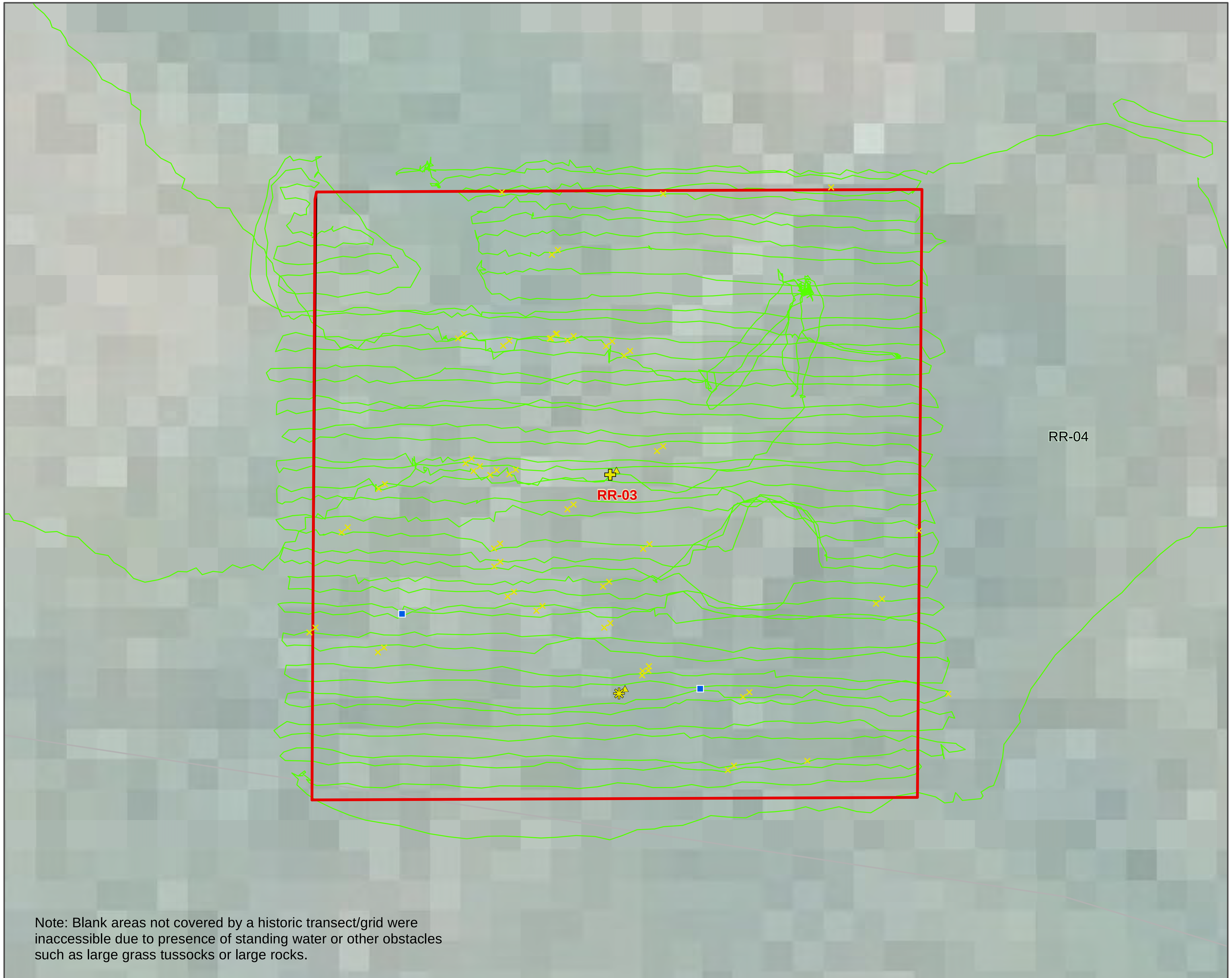


VICINITY MAP

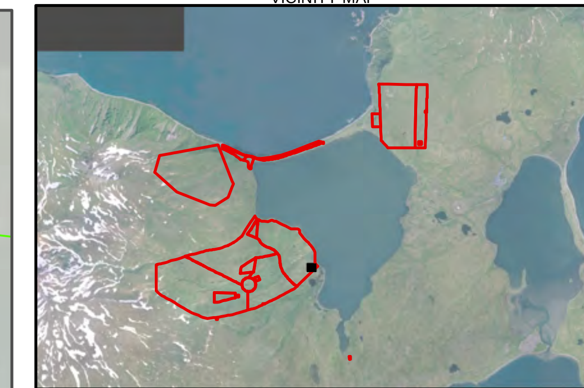


Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

FIGURE 7-15
RR-02 Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska



VICINITY MAP



MEC Investigation

- Pre-2008 Unexploded Ordnance (UXO)
- Pre-2008 Discarded Military Munitions (DMM)
- Pre-2008 Material Presenting Potential Explosive Hazard (MPPEH)
- Pre-2008 Other (not munitions-related material)
- Pre-2008 Geophysical Survey Transect

MC Investigation

- Pre-2008 Soil Sample

Topography and Site Features

- Subject AOC
- AOC
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

0 10 20
Feet

N

FIGURE 7-16
RR-03 Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska

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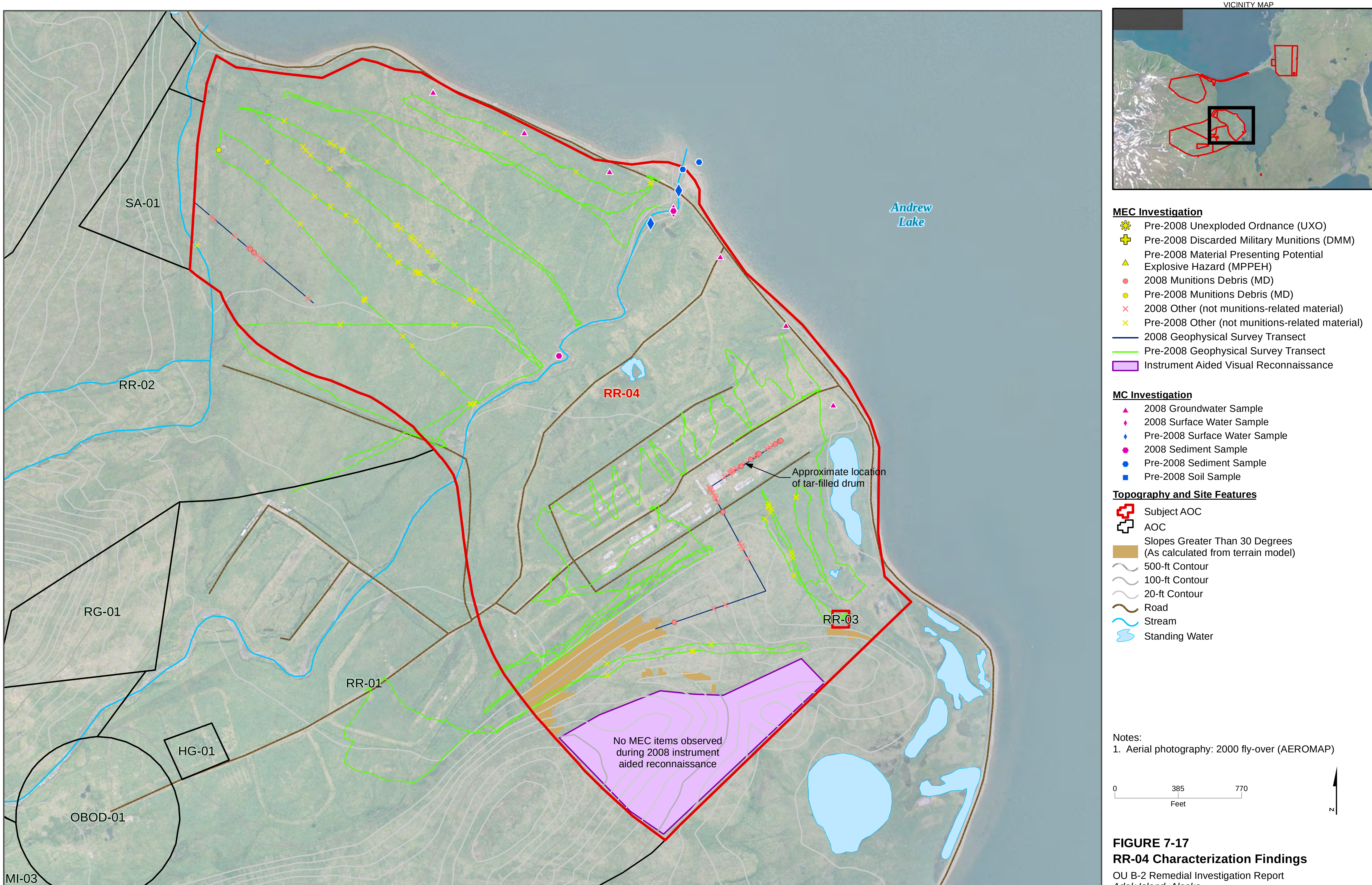

MEC Investigation

- Pre-2008 Unexploded Ordnance (UXO)
- Pre-2008 Discarded Military Munitions (DMM)
- Pre-2008 Material Presenting Potential Explosive Hazard (MPPEH)
- 2008 Munitions Debris (MD)
- Pre-2008 Munitions Debris (MD)
- 2008 Other (not munitions-related material)
- Pre-2008 Other (not munitions-related material)
- 2008 Geophysical Survey Transect
- Pre-2008 Geophysical Survey Transect
- Instrument Aided Visual Reconnaissance

MC Investigation

- 2008 Groundwater Sample
- 2008 Surface Water Sample
- Pre-2008 Surface Water Sample
- 2008 Sediment Sample
- Pre-2008 Sediment Sample
- Pre-2008 Soil Sample

Topography and Site Features

- Subject AOC
- AOC
- Slopes Greater Than 30 Degrees (As calculated from terrain model)
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

0 385 770
Feet

N

FIGURE 7-17
RR-04 Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska

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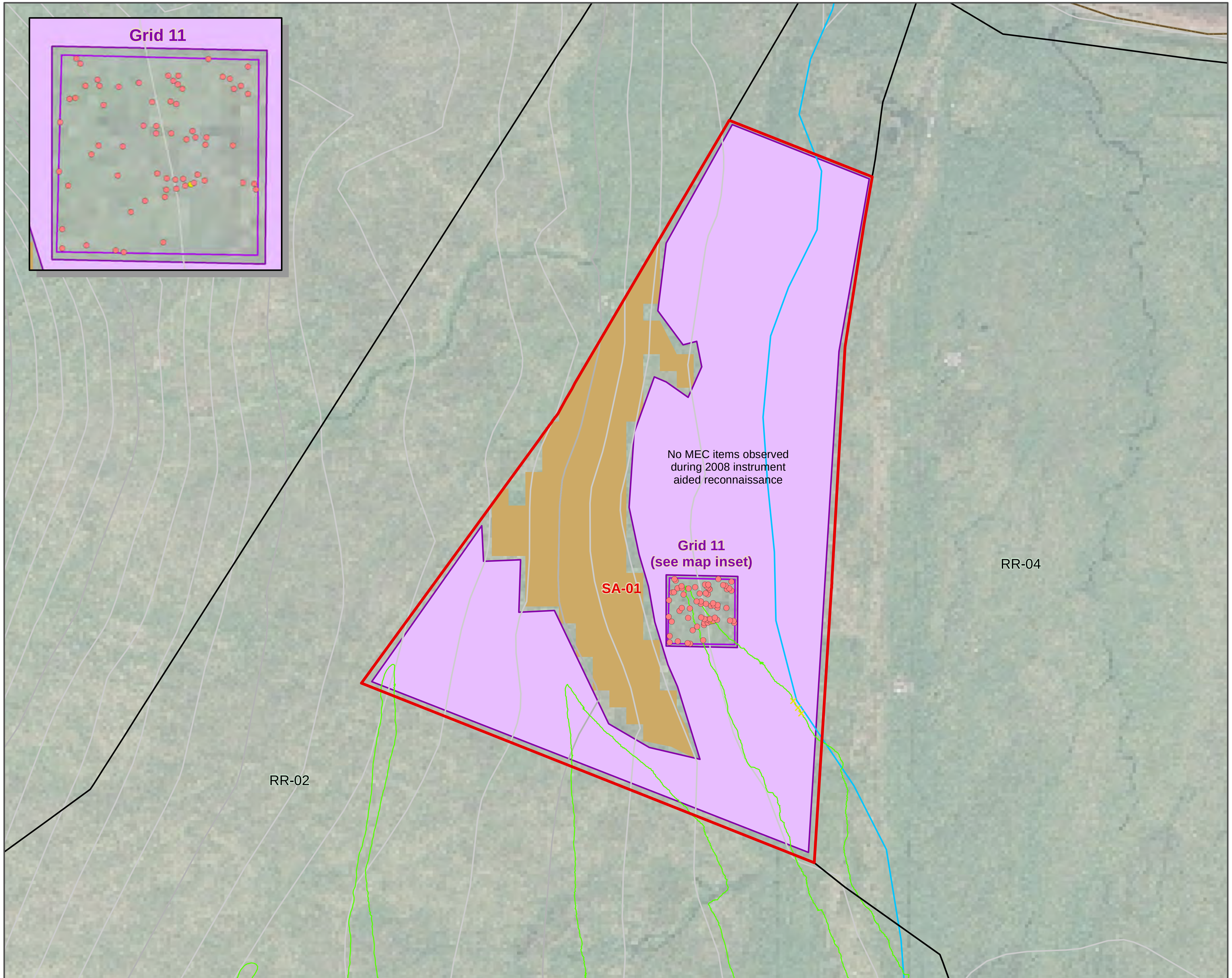
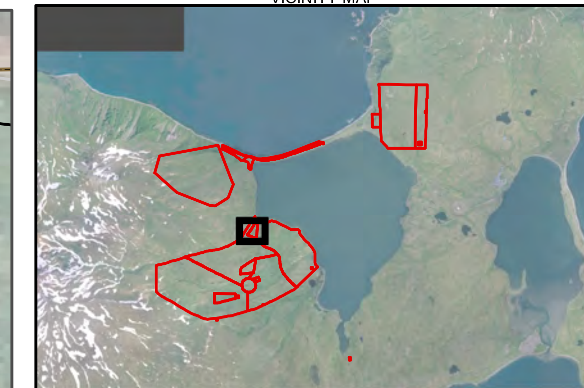


VICINITY MAP



MEC Investigation

- 2008 Munitions Debris (MD)
- Pre-2008 Munitions Debris (MD)
- Pre-2008 Other (not munitions-related material)
- Pre-2008 Geophysical Survey Transect
- Grid
- Instrument Aided Visual Reconnaissance

Topography and Site Features

- Subject AOC
- AOC
- Slopes Greater Than 30 Degrees (As calculated from terrain model)
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

0 105 210
Feet

N

FIGURE 7-18
SA-01 Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska

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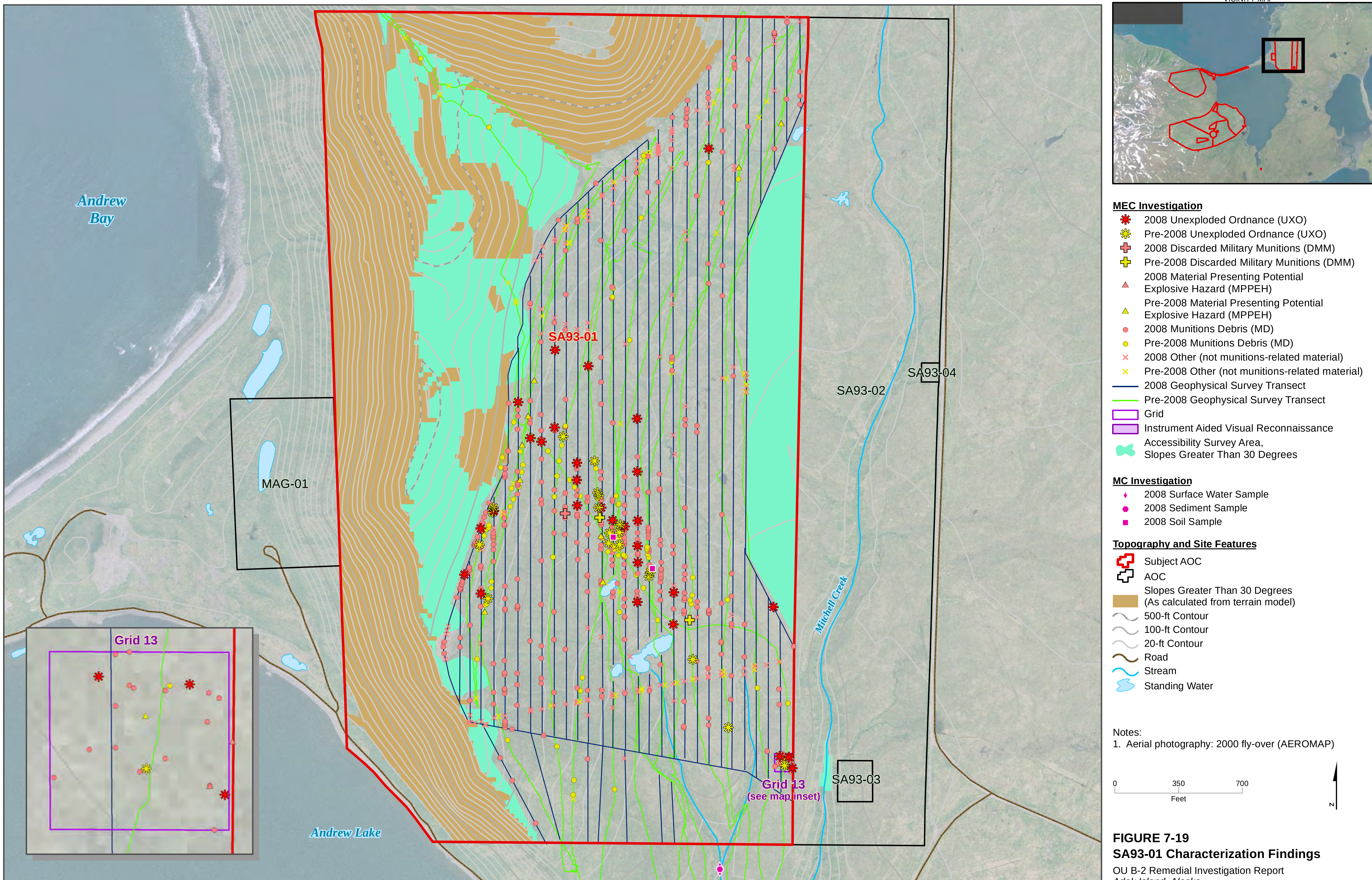

MEC Investigation
- 2008 Unexploded Ordnance (UXO)
- Pre-2008 Unexploded Ordnance (UXO)
- 2008 Discarded Military Munitions (DMM)
- Pre-2008 Discarded Military Munitions (DMM)
- 2008 Material Presenting Potential Explosive Hazard (MPPEH)
- Pre-2008 Material Presenting Potential Explosive Hazard (MPPEH)
- 2008 Munitions Debris (MD)
- Pre-2008 Munitions Debris (MD)
- 2008 Other (not munitions-related material)
- Pre-2008 Other (not munitions-related material)
- 2008 Geophysical Survey Transect
- Pre-2008 Geophysical Survey Transect
- Grid
- Instrument Aided Visual Reconnaissance
- Accessibility Survey Area, Slopes Greater Than 30 Degrees

MC Investigation
- 2008 Surface Water Sample
- 2008 Sediment Sample
- 2008 Soil Sample

Topography and Site Features
- Subject AOC
- AOC
- Slopes Greater Than 30 Degrees (As calculated from terrain model)
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

0 350 700
Feet

N

FIGURE 7-19
SA93-01 Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska

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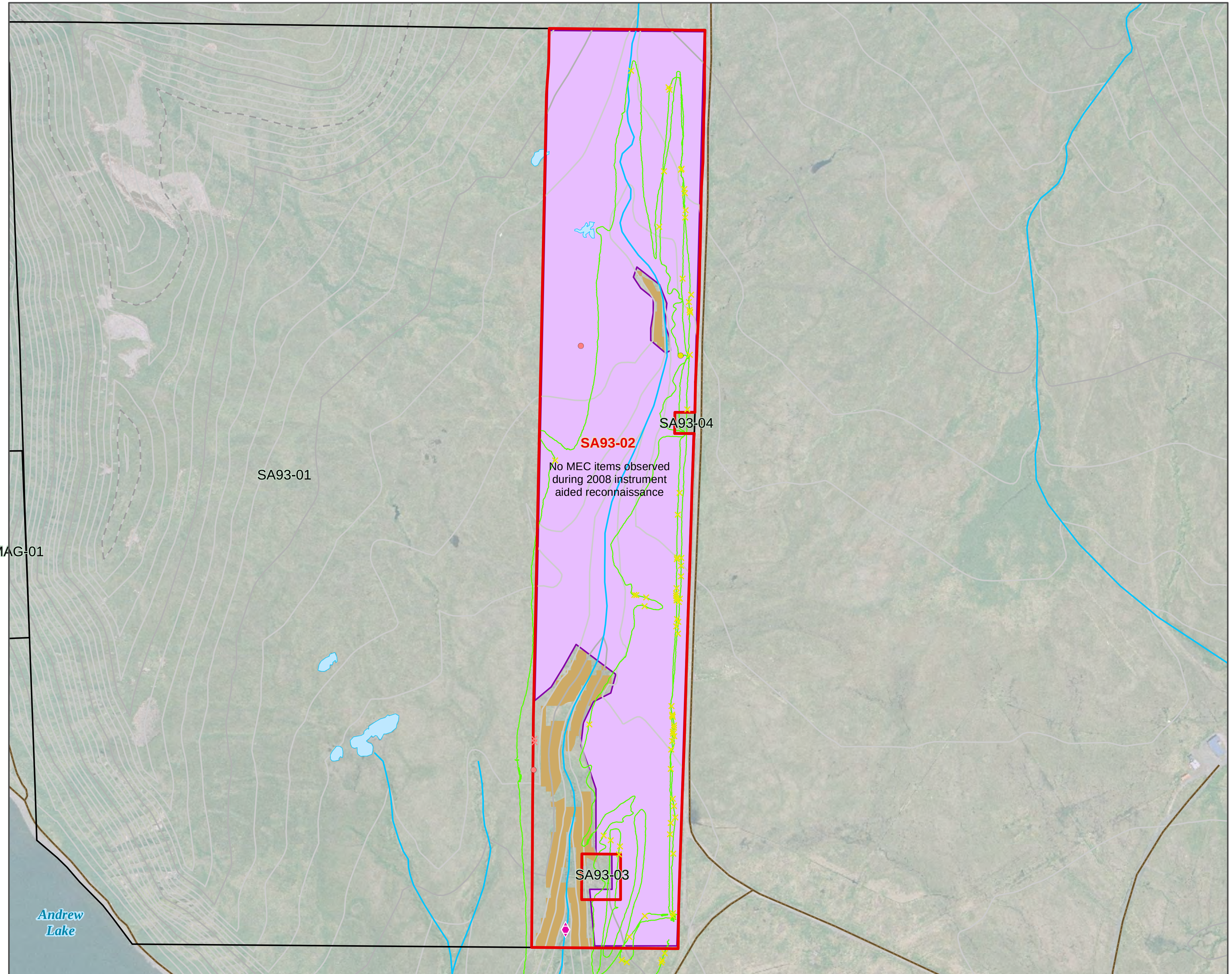

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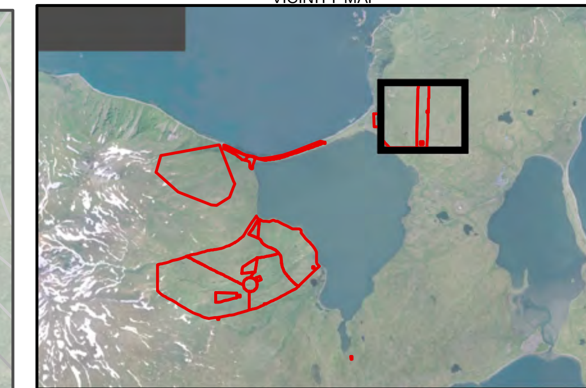

MEC Investigation
- 2008 Munitions Debris (MD)
- Pre-2008 Munitions Debris (MD)
- 2008 Other (not munitions-related material)
- Pre-2008 Other (not munitions-related material)
- Pre-2008 Geophysical Survey Transect
- Instrument Aided Visual Reconnaissance

MC Investigation
- 2008 Surface Water Sample
- 2008 Sediment Sample

Topography and Site Features
- Subject AOC
- AOC
- Slopes Greater Than 30 Degrees (As calculated from terrain model)
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

0 350 700
Feet

N

FIGURE 7-20
SA93-02 Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska

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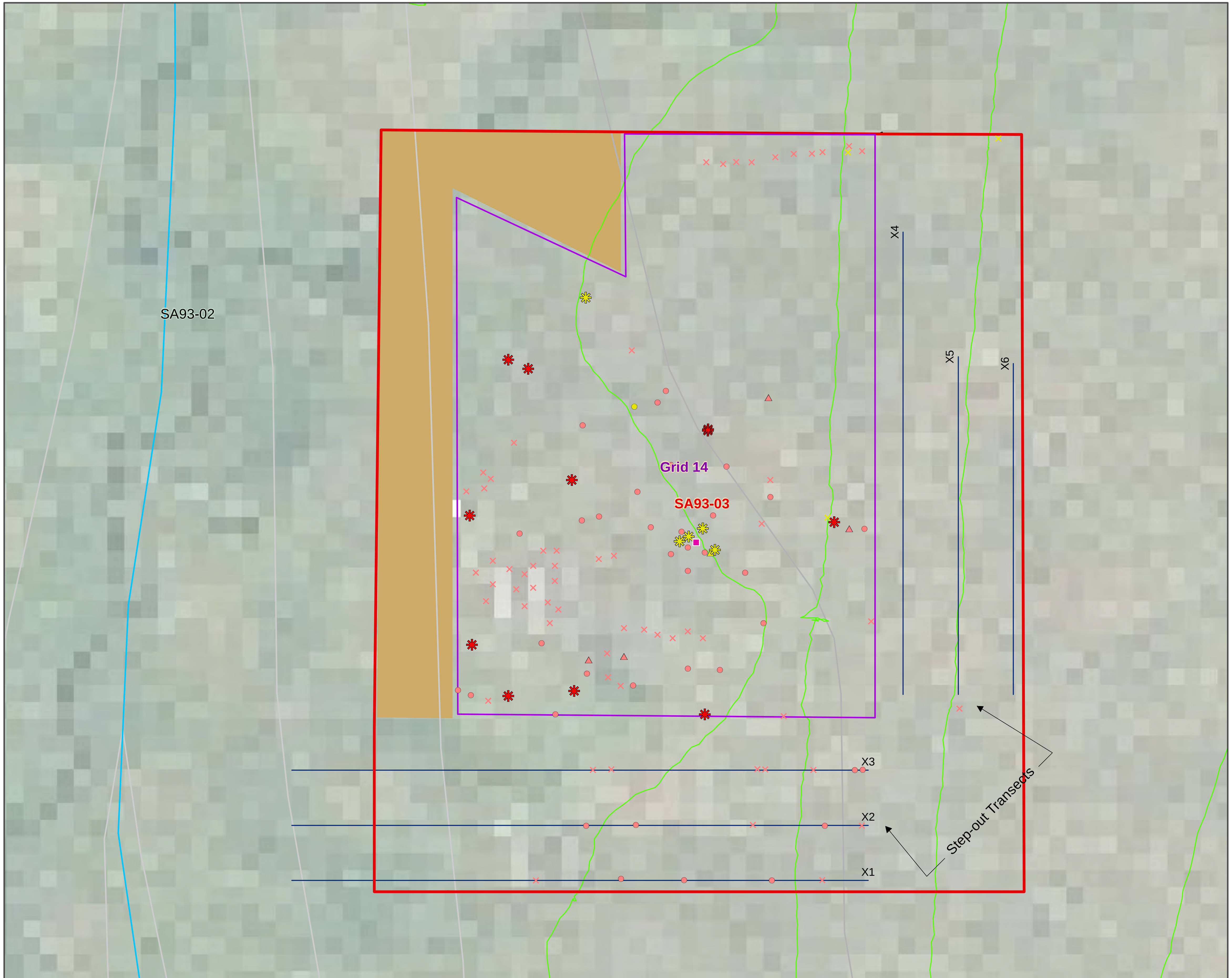
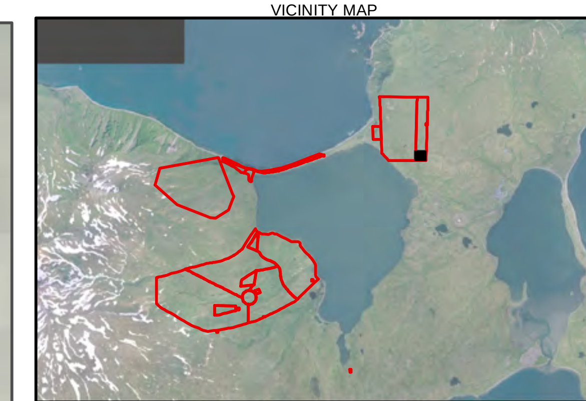


VICINITY MAP



MEC Investigation

- 2008 Unexploded Ordnance (UXO)
- Pre-2008 Unexploded Ordnance (UXO)
- 2008 Material Presenting Potential Explosive Hazard (MPPEH)
- Pre-2008 Material Presenting Potential Explosive Hazard (MPPEH)
- 2008 Munitions Debris (MD)
- Pre-2008 Munitions Debris (MD)
- 2008 Other (not munitions-related material)
- Pre-2008 Other (not munitions-related material)
- 2008 Geophysical Survey Transect
- Pre-2008 Geophysical Survey Transect
- Grid

MC Investigation

- 2008 Soil Sample

Topography and Site Features

- Subject AOC
- AOC
- Slopes Greater Than 30 Degrees (As calculated from terrain model)
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

0 20 40
Feet

N

FIGURE 7-21
SA93-03 Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska

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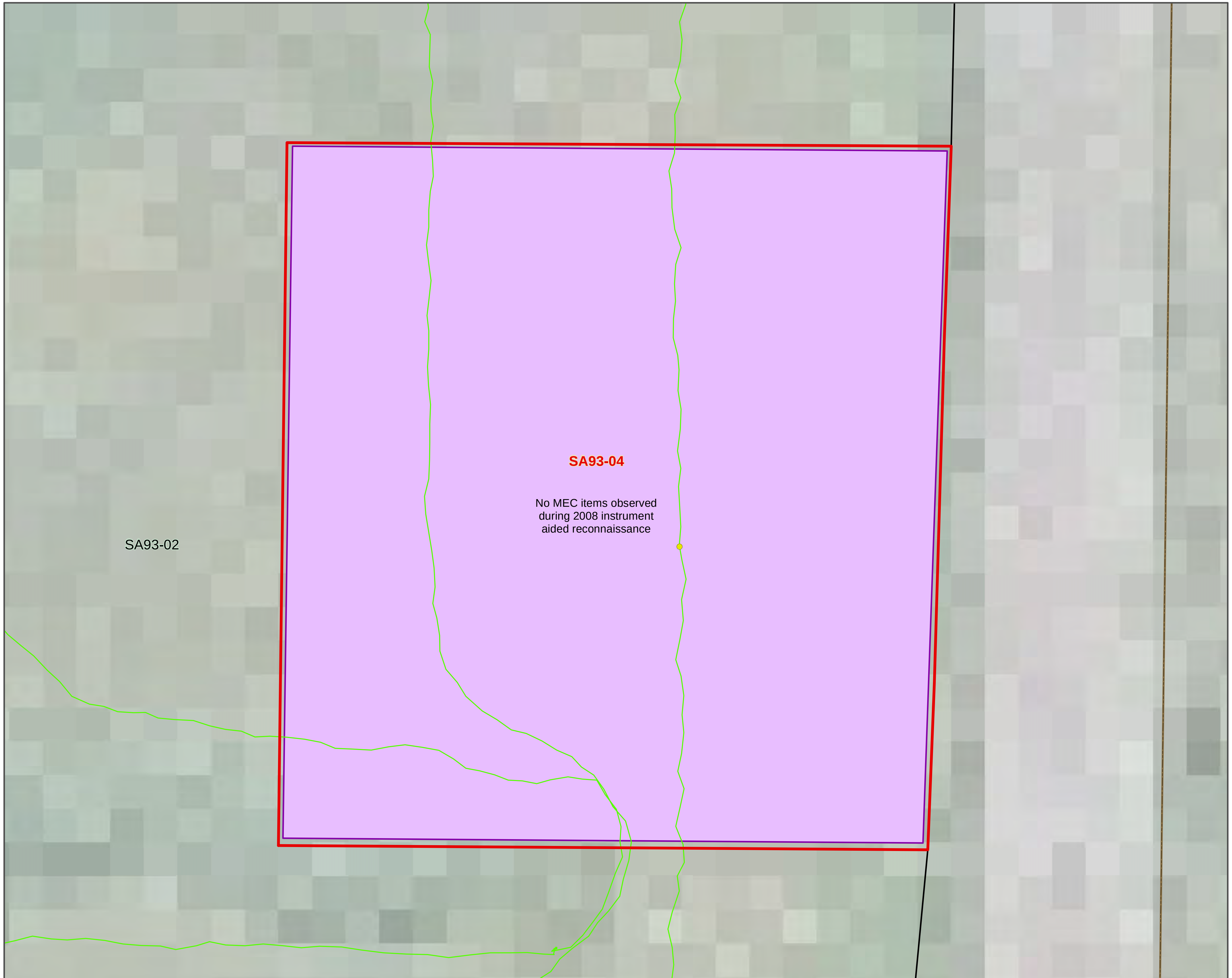
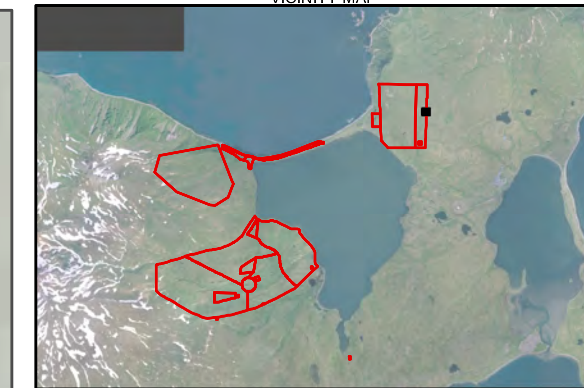


VICINITY MAP



MEC Investigation

- Pre-2008 Munitions Debris (MD)
- Pre-2008 Geophysical Survey Transect
- Instrument Aided Visual Reconnaissance

Topography and Site Features

- Subject AOC
- AOC
- 500-ft Contour
- 100-ft Contour
- 20-ft Contour
- Road
- Stream
- Standing Water

Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

0 10 20
Feet

N

FIGURE 7-22
SA93-04 Characterization Findings
OU B-2 Remedial Investigation Report
Adak Island, Alaska

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SECTION 8

Explosives Safety Hazard Assessment

This section describes the ESHA methodology for Adak and presents the results of ESHA evaluations for each AOC in OU B-2.

8.1 Adak ESHA Methodology

The Adak ESHA methodology was developed by the OU B Project Team – Hazardous Assessment Working Group as part of the overall framework for assessing and managing potential threats because of the presence of MEC on Adak Island. Potential threats associated with the release of hazardous chemicals (e.g., MC) are addressed through established risk assessment procedures under CERCLA developed under Superfund regulations[1], which has no special provisions for dealing with MEC safety or hazards. Ordnance has unique properties that influence their release and transport mechanisms, the potential for contact and exposure, and the effects of that exposure. The ESHA methodology establishes a risk, or hazard, assessment process for MEC on Adak that is consistent with CERCLA principles and acceptable to Adak stakeholders. A copy of the Adak ESHA methodology guidance document is provided in Appendix K.

Figure 8-1 presents the logical flowchart for the Adak ESHA methodology and illustrates four primary hazard factors:

1. Ordnance Search/Removal Status (that is, what is currently known about the likelihood and distribution of ordnance present in the area)
2. Ordnance Characteristics (that is, the explosive properties of the MEC found at the site)
3. Ordnance Accessibility (that is, the potential for direct contact with ordnance items)
4. Public Exposure (that is, the nature of public access and the activities performed in the area)

The flowchart reflects the following premises about ordnance risk or hazard on Adak:

- Areas where MEC are known or indicated to be present create more potential for explosive hazards than areas where MEC has been purposefully searched for and has not been found or where all known ordnance has been removed
- Different types of ordnance present more or less potential to detonate if disturbed, and, if detonated, can produce a range of adverse consequences
- The potential for explosive hazards is created when ordnance is located where it is likely to be disturbed by current and/or future land use activities
- The potential for explosive risk is greater where public exposure is greatest (for example, increased contact or easier accessibility)

[1] The risk assessment findings for MC are presented in Section 8.

FIGURE 8-1
Adak ESHA Methodology Flowchart

Ordnance Search/Removal Status Hazard Factor	Ordnance Characteristics Hazard Factor	Ordnance Accessibility Hazard Factor	Public Exposure Hazard Factor
Subfactor • **Ordnance Search/Removal Status**	**Subfactors** • **Ordnance Hazard Severity** (includes Ordnance Type and Fuzing) • **Amount of Energetic Material** (Impact Scale)	**Subfactors** • **Level of Public Activity** (Intrusion Depth) • **Depth Below Ground Surface** • **Migration/Erosion Potential** (Because of Natural Processes)	**Subfactors** • **Frequency of Public Access** (includes Ease of Access and Current and/or Future Land Use) • **Intensity of Public Activity** (Energy Imparted to the Ground) • **Portability**
⇩	⇩	⇩	⇩
⇩	**Ordnance Characteristics Weighting Factors and Scoring Rules**	**Ordnance Accessibility Weighting Factors and Scoring Rules**	**Public Exposure Weighting Factors and Scoring Rules**
⇩	⇩	⇩	⇩
QUALITATIVE ORDNANCE SEARCH/REMOVAL STATUS SCORE	**QUALITATIVE ORDNANCE CHARACTERISTICS SCORE**	**QUALITATIVE ORDNANCE ACCESSIBILITY SCORE**	**QUALITATIVE PUBLIC EXPOSURE SCORE**
⇩	⇩	⇩	⇩
Explosives Safety Hazard Weighting Factors and Scoring Rules			
⇩			
EXPLOSIVES SAFETY HAZARD CATEGORY			
Final Explosives Safety Hazard Score: **A (Lowest Relative Hazard Level)** **B**		**Management Option:** **"Adak NOFA"/Baseline Institutional Controls**	
C **D** **E (Highest Relative Hazard Level)**		**"Evaluate in the Feasibility Study"**	

As shown in Figure 8-1, the four primary hazard factors have subfactors that reflect conditions and exposure circumstances on Adak and to meet stakeholders' needs, as shown in Table 8-1.

The factor and subfactor inputs to the Adak ESHA methodology are both quantitative and qualitative; the overall framework and ESHA scoring are qualitative in nature. The ESHA assigns relative scores to qualitative estimates of the MEC, but does not define quantitative measures of known MEC risk. Although five separate hazard scores ranging from a low of A to a high of E are possible, there are only two possible outcomes related to the RI: (1) Adak no further action (Adak NOFA) with baseline institutional controls or (2) further evaluation of active remedies in the FS.

TABLE 8-1
ESHA Hazard Factors and Subfactors

ESHA Hazard Factors	ESHA Subfactors
1. Ordnance Search/Removal Status	Ordnance Search/Removal Status
2. Ordnance Characteristics	Ordnance Hazard Severity (Type and Fuzing)[a] Amount of Energetic Material (Impact Scale)[b]
3. Ordnance Accessibility	Depth Below Ground Surface Migration/Erosion Potential Level of Public Activity (Intrusion Depth)
4. Public Exposure	Frequency of Public Access (ease of access and current and/or future land use) Intensity of Public Activity (energy Imparted to the ground) Portability

[a]If multiple types of ordnance are present, the hazard severity is based on the most hazardous item found.

[b]If multiple types of ordnance are present, the amount of energetic material is based on the item with the most energetic material.

8.2 AOC-Specific ESHA Results

This section describes the scoring parameters used to complete the ESHA methodology and presents the results of the ESHA for each AOC requiring such evaluation.

Site-specific scoring details and results for each AOC are provided in the following subsections.

8.2.1 ESHA Results for ALDA-01

ALDA-01 received a score of C, indicating that further evaluation and/or response actions may be needed to reduce risk to the public. All accessible portions of the AOC were surveyed, but only limited intrusive investigation was conducted because of the density of anomalies. Isolated MEC and MPPEH items were found intermingled with subsurface metal debris in trenches dug through areas of dense anomalies during the 1999 SI. Additional MEC, including 60-mm mortars, were found at the surface, but these occurrences appear to be related to wash-up from offshore areas. Table 8-2 summarizes the input categories that generated this ESHA score.

TABLE 8-2
ESHA Results for ALDA-01

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	MEC known or indicated to be present, as determined from 100% survey and limited investigation of anomalies during 1999 SI. MEC found at depth intermixed with debris and on surface.
MEC Characteristics	
MEC Hazard Severity	Marginal (40-mm projectile)
Amount of Energetic Material	<0.5 pound net explosive weight (NEW)
MEC Accessibility	
Intrusive Depth	Moderate
Depth Below Ground Surface	Any item < 1 foot bgs
Migration/Erosion Potential	Very stable
Public Exposure	
Ease of Access	Established trail access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Easily Portable

Current ESHA Score: C
Disposition: Further evaluation is needed—forward to the FS

8.2.2 ESHA Results for ALDA-02

ALDA-02 received a score of A, indicating that the site poses minimal risk to the public but that baseline institutional controls (e.g., educational awareness) may be needed. Table 8-3 summarizes the input categories that generated this ESHA score.

TABLE 8-3
ESHA Results for ALDA-02

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	No MEC encountered as determined from site walks during 1999 SI
MEC Characteristics	
MEC Hazard Severity	None
Amount of Energetic Material	<0.5 pound NEW
MEC Accessibility	
Intrusive Depth	Moderate
Depth Below Ground Surface	No score (no MEC)
Migration/Erosion Potential	Moderate
Public Exposure	
Ease of Access	No established access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Easily Portable

Current ESHA Score: A
Disposition: Adak NOFA with baseline institutional controls
Score to be re-evaluated following 2012 reconnaissance

8.2.3 ESHA Results for ALSW-01

The beach and upland portion of ALSW-01 received a score of D, indicating that further evaluation and/or response actions may be needed to reduce the risk to the public. DMM, most likely related to wash-up from an offshore area, were discovered during annual surface sweeps. Table 8-4 summarizes the site characteristics relevant to the ESHA scoring.

TABLE 8-4
ESHA Results for ALSW-01

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	DMM present, as determined from annual surface sweeps
MEC Characteristics	
MEC Hazard Severity	Critical
Amount of Energetic Material	1 to 10 pounds NEW (81mm, 2.05 pounds)
MEC Accessibility	
Intrusive Depth	Minor (max of 1 foot - seawall)
Depth Below Ground Surface	Any item < 1 foot bgs
Migration/Erosion Potential	Significant
Public Exposure	
Ease of Access	Established trail access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Easily portable

Current ESHA Score: D
Disposition: Further evaluation is needed—forward to the FS

8.2.4 ESHA Results for BC-03

BC-03 received a score of A, indicating that the site poses minimal risk to the public, but that baseline institutional controls may be needed. Table 8-5 summarizes the input categories that generated this ESHA score.

TABLE 8-5
ESHA Results for BC-03

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	No MEC encountered, as determined from 1999 instrument-aided reconnaissance of accessible areas
MEC Characteristics	
MEC Hazard Severity	None
Amount of Energetic Material	< 0.5 pound NEW
MEC Accessibility	
Intrusive Depth	Minor
Depth Below Ground Surface	None (no MEC)
Migration/Erosion Potential	Moderate
Public Exposure	
Ease of Access	No established access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Easily Portable
Current ESHA Score: A	
Disposition: Adak NOFA with baseline institutional controls	

8.2.5 ESHA Results for C1-01

C1-01 received a score of D, indicating that further evaluation and/or response actions may be needed to reduce the risk to the public.

Multiple MEC were encountered on the surface, and based on MEC type, amount of energetic materials found, accessibility, and land use, C1-01 yielded an ESHA score of D. Table 8-6 summarizes the input categories that generated this ESHA score.

TABLE 8-6
ESHA Results for C1-01

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	MEC present, as determined from 100% geophysical surveys and intrusive investigations conducted in 1999 and 2000 (Note: transect pattern did not consider 20 mm projectiles)
MEC Characteristics	
MEC Hazard Severity	Critical (40 mm projectiles)
Amount of Energetic Material	1 to 10 pounds NEW (81 mm, 2.05 pounds)
MEC Accessibility	
Intrusive Depth	Minor
Depth Below Ground Surface	Any item < 1 foot bgs
Migration/Erosion Potential	Moderate
Public Exposure	
Ease of Access	No established access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Easily Portable
Current ESHA Score: D	
Disposition: Further evaluation is needed—forward to the FS	

8.2.6 ESHA Results for HG-01

Based on conditions following the 2008 investigation, wherein all previously uninvestigated anomalies were intrusively investigated and all MEC items were removed and destroyed (additional MEC items were found in investigated areas and cleared in 1999), HG-01 received a score of D, indicating that further evaluation and/or response actions may be needed to reduce the risk to the public. Table 8-7 summarizes the input categories that generated this ESHA score.

TABLE 8-7
ESHA Results for HG-01

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	100% geophysical survey and clearance in 1999 and 2008. Possible quality issues associated with 1999 investigation because of 2008 MEC finds in previously surveyed/investigated area
MEC Characteristics	
MEC Hazard Severity	Catastrophic (40 mm)
Amount of Energetic Material	< 0.5 pound NEW (40 mm M406)
MEC Accessibility	
Intrusive Depth	Moderate
Depth Below Ground Surface	Any item < 1 foot bgs
Migration/Erosion Potential	Very stable
Public Exposure	
Ease of Access	Established trail access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Easily Portable

Current ESHA Score: D
Disposition: Further evaluation is needed—forward to the FS

8.2.7 ESHA Results for JM-01

JM-01 received a score of A, indicating that the site poses minimal risk to the public but that baseline institutional controls may be needed. Table 8-8 summarizes the input categories that generated this ESHA score.

TABLE 8-8
ESHA Results for JM-01

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	No MEC encountered (site not located)
MEC Characteristics	
MEC Hazard Severity	Not covered by score
Amount of Energetic Material	Site not located
MEC Accessibility	
Intrusive Depth	Moderate
Depth Below Ground Surface	No score (not located)
Migration/Erosion Potential	Moderate
Public Exposure	
Ease of Access	Not located
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Easily Portable

Current ESHA Score: A
Disposition: Adak NOFA with baseline institutional controls

8.2.8 ESHA Results for LJ-02A

LJ-02A received a score of A, indicating that the site poses minimal risk to the public but that baseline institutional controls may be needed. Table 8-9 summarizes the input categories that generated this ESHA score.

TABLE 8-9
ESHA Results for LJ-02A

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	No MEC encountered during 2002 geophysical and intrusive investigation
MEC Characteristics	
MEC Hazard Severity	None
Amount of Energetic Material	< 0.5 pound NEW
MEC Accessibility	
Intrusive Depth	Moderate
Depth Below Ground Surface	None (no MEC)
Migration/Erosion Potential	Moderate
Public Exposure	
Ease of Access	Established trail access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Easily Portable

Current ESHA Score: A
Disposition: Adak NOFA with baseline institutional controls

8.2.9 ESHA Results for MAG-01

Based on the ESHA process, MAG-01 received a score of A, indicating that the site poses minimal risk to the public but that baseline institutional controls may be needed.

Historical records indicate the potential presence of MEC based on the proximity of gun emplacements. However, the most recent site investigation revealed no evidence of MEC or the storage magazine. Table 8-10 summarizes the site characteristics relevant to the ESHA scoring.

TABLE 8-10
ESHA Results for MAG-01

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	No MEC present and no evidence of storage magazine in area, as determined from instrument-aided visual inspection and site reconnaissance conducted in 2008
MEC Characteristics	
MEC Hazard Severity	None
Amount of Energetic Material	< 0.5 pound NEW
MEC Accessibility	
Intrusive Depth	Moderate
Depth Below Ground Surface	None (no MEC)
Migration/Erosion Potential	Moderate
Public Exposure	
Ease of Access	Established trail access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Easily Portable

Current ESHA Score: A
Disposition: Adak NOFA with baseline institutional controls

8.2.10 ESHA Results for MI-01

Based on the ESHA process, MI-01 received a score of D, indicating that further evaluation and/or response actions may be needed to reduce the risk to the public. Table 8-11 summarizes the input categories that generated this ESHA score.

TABLE 8-11
ESHA Results for MI-01

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	MEC present, as determined from geophysical surveys and intrusive investigations conducted in 1999 and 2008
MEC Characteristics	
MEC Hazard Severity	Catastrophic (grenades)
Amount of Energetic Material	< 0.5 pound NEW (40 mm)
MEC Accessibility	
Intrusive Depth	Moderate
Depth Below Ground Surface	Any item < 1 foot bgs
Migration/Erosion Potential	Moderate
Public Exposure	
Ease of Access	Established trail access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Easily Portable

Current ESHA Score: D
Disposition: Further evaluation is needed—forward to the FS

8.2.11 ESHA Results for MI-02

Based on the ESHA process, MI-02 received a score of D, indicating that further evaluation and/or response actions may be needed to reduce the risk to the public. Table 8-12 summarizes the input categories that generated this ESHA score.

TABLE 8-12
ESHA Results for MI-02

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	MEC present, as determined from geophysical surveys and intrusive investigations conducted in 1999 and 2008
MEC Characteristics	
MEC Hazard Severity	Critical (40 mm projectiles)
Amount of Energetic Material	1 to 10 pounds NEW (2.36-inch rocket, 1.6 pounds HE)
MEC Accessibility	
Intrusive Depth	Moderate
Depth Below Ground Surface	Any item < 1 foot bgs
Migration/Erosion Potential	Moderate
Public Exposure	
Ease of Access	Established trail access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Easily Portable

Current ESHA Score: D
Disposition: Further evaluation is needed—forward to the FS

8.2.12 ESHA Results for MI-03

Based on the ESHA process, MI-03 received a score of D, indicating that further evaluation and/or response actions may be needed to reduce risk to the public. Table 8-13 summarizes the input categories that generated this ESHA score.

TABLE 8-13
ESHA Results for MI-03

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	MEC present, as determined from geophysical surveys and intrusive investigations conducted in 1999 and 2008
MEC Characteristics	
MEC Hazard Severity	Catastrophic (grenades)
Amount of Energetic Material	< 0.5 pound NEW (40 mm projectile)
MEC Accessibility	
Intrusive Depth	Moderate
Depth Below Ground Surface	Any item < 1 foot bgs
Migration/Erosion Potential	Moderate
Public Exposure	
Ease of Access	Established trail access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Easily Portable

Current ESHA Score: D
Disposition: Further evaluation is needed—forward to the FS

8.2.13 ESHA Results for MM-10D

MM-10D received a score of A, indicating that the site poses minimal risk to the public, but that baseline institutional controls may be needed. Table 8-14 summarizes the input categories that generated this ESHA score.

TABLE 8-14
ESHA Results for MM-10D

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	No MEC encountered during 1999 and 2000 geophysical surveys and intrusive investigations
MEC Characteristics	
MEC Hazard Severity	None
Amount of Energetic Material	< 0.5 pound NEW
MEC Accessibility	
Intrusive Depth	Moderate
Depth Below Ground Surface	None (no MEC)
Migration/Erosion Potential	Moderate
Public Exposure	
Ease of Access	Established trail access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Easily Portable

Current ESHA Score: A
Disposition: Adak NOFA with baseline institutional controls

8.2.14 ESHA Results for OB/OD-01

Based on the ESHA process, OB/OD-01 received a score of D, indicating that further evaluation and/or response actions may be needed to reduce the risk to the public. Table 8-15 summarizes the input categories that generated this ESHA score.

TABLE 8-15
ESHA Results for OB/OD-01

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	MEC present, as determined from geophysical survey and intrusive investigation conducted in 1999 SI
MEC Characteristics	
MEC Hazard Severity	Critical (fuzing, no 40 mm)
Amount of Energetic Material	1 to10 pounds NEW (2.36-inch rocket, 1.6 pound HE)
MEC Accessibility	
Intrusive Depth	Moderate
Depth Below Ground Surface	Any item < 1 foot bgs
Migration/Erosion Potential	Moderate
Public Exposure	
Ease of Access	Established trail access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Easily Portable

Current ESHA Score: D
Disposition: Further evaluation is needed—forward to the FS

8.2.15 ESHA Results for RG-01

Although technically not part of the RI for OU B-2, RG-01 is located within the OU B-2 and required rescoring following the completion of 2008 NTCRA. These activities included 100 percent geophysical survey and clearance of MEC to a depth of 2 feet, as documented in the After Action Report (USAE 2009). RG-01 received an ESHA score of A, indicating that the site now poses minimal risk to the public, but that baseline institutional controls may be needed. Table 8-16 summarizes the site characteristics relevant to the ESHA scoring.

TABLE 8-16
ESHA Results for RG-01

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	No MEC remains following 100% investigation and clearance during 2006 and 2008 NTCRA
MEC Characteristics	
MEC Hazard Severity	None
Amount of Energetic Material	<0.5 pound NEW
MEC Accessibility	
Intrusive Depth	Moderate
Depth Below Ground Surface	None (no MEC)
Migration/Erosion Potential	Moderate
Public Exposure	
Ease of Access	Established trail access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Easily Portable

Current ESHA Score: A
Disposition: Adak NOFA with baseline institutional controls

8.2.16 ESHA Results for RR-01

Based on the ESHA process, RR-01 received a score of D, indicating that further evaluation and/or response actions may be needed to reduce the risk to the public. Table 8-17 summarizes the input categories that generated this ESHA score.

TABLE 8-17
ESHA Results for RR-01

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	MEC present, as determined from geophysical surveys and intrusive investigations conducted in 1999 and 2008
MEC Characteristics	
MEC Hazard Severity	Catastrophic (40 mm)
Amount of Energetic Material	1 to10 pounds NEW (2.36-in rocket, 1.6 pounds HE)
MEC Accessibility	
Intrusive Depth	Moderate
Depth Below Ground Surface	Any item < 1 foot bgs
Migration/Erosion Potential	Very stable
Public Exposure	
Ease of Access	Established trail access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Easily Portable

Current ESHA Score: D
Disposition: Further evaluation is needed—forward to the FS

8.2.17 ESHA Results for RR-02

Based on the ESHA process, RR-02 received an ESHA score of A, indicating that the site poses minimal risk to the public, but that baseline institutional controls may be needed. Table 8-18 summarizes the site characteristics relevant to the ESHA scoring.

TABLE 8-18
ESHA Results for RR-02

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	No MEC encountered, as determined from 1999 and 2008 geophysical surveys and intrusive investigations, as well as from the 2008 instrument-aided visual inspection and site reconnaissance of the accessible, northeastern, southwestern, and western portions of the AOC.
MEC Characteristics	
MEC Hazard Severity	None
Amount of Energetic Material	< 0.5 pound NEW
MEC Accessibility	
Intrusive Depth	Moderate
Depth Below Ground Surface	None (no MEC)
Migration/Erosion Potential	Moderate
Public Exposure	
Ease of Access	Established trail access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Low

Current ESHA Score: A
Disposition: Adak NOFA with baseline institutional controls

8.2.18 ESHA Results for RR-03

RR-03 received a score of A, indicating that the site poses minimal risk to the public, but that baseline institutional controls may be needed. Table 8-19 summarizes the input categories that generated this ESHA score.

TABLE 8-19
ESHA Results for RR-03

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	No MEC remains, as determined from 1999 and 2000 geophysical surveys and intrusive investigations
MEC Characteristics	
MEC Hazard Severity	None
Amount of Energetic Material	< 0.5 pound NEW
MEC Accessibility	
Intrusive Depth	Moderate
Depth Below Ground Surface	None (no MEC)
Migration/Erosion Potential	Moderate
Public Exposure	
Ease of Access	Established trail access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Low

Current ESHA Score: A
Disposition: Adak NOFA with baseline institutional controls

8.2.19 ESHA Results for RR-04

Based on the ESHA process, RR-04 received an ESHA score of A, indicating that the site poses minimal risk to the public, but that baseline institutional controls may be needed. Table 8-20 summarizes the site characteristics relevant to the ESHA scoring.

TABLE 8-20
ESHA Results for RR-04

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	No MEC encountered, as determined from 1999 and 2008 geophysical surveys and intrusive investigations, as well as from the 2008 instrument-aided visual inspection and site reconnaissance of the accessible southwestern portion of the AOC
MEC Characteristics	
MEC Hazard Severity	None
Amount of Energetic Material	< 0.5 pound NEW
MEC Accessibility	
Intrusive Depth	Moderate
Depth Below Ground Surface	None (no MEC)
Migration/Erosion Potential	Moderate
Public Exposure	
Ease of Access	Established trail access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Low

Current ESHA Score: A
Disposition: Adak NOFA with baseline institutional controls

8.2.20 ESHA Results for SA-01

Based on the ESHA process, SA-01 received an ESHA score of A, indicating that the site poses minimal risk to the public, but that baseline institutional controls may be needed. Table 8-21 summarizes the site characteristics relevant to the ESHA scoring.

TABLE 8-21
ESHA Results for SA-01

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	No MEC encountered, as determined from the 2008 geophysical survey and intrusive investigation and the 2008 instrument-aided visual reconnaissance
MEC Characteristics	
MEC Hazard Severity	None
Amount of Energetic Material	< 0.5 pound NEW
MEC Accessibility	
Intrusive Depth	Moderate
Depth Below Ground Surface	None (no MEC)
Migration/Erosion Potential	Moderate
Public Exposure	
Ease of Access	Established trail access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Easily portable

Current ESHA Score: A
Disposition: Adak NOFA with baseline institutional controls

8.2.21 ESHA Results for SA93-01

SA93-01 received an ESHA score of D, indicating that further evaluation and/or response actions may be needed to reduce the risk to the public. Table 8-22 summarizes the input categories that generated this ESHA score.

TABLE 8-22
ESHA Results for SA93-01

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	MEC present, as determined from geophysical surveys and intrusive investigations conducted in 1999 and 2008
MEC Characteristics	
MEC Hazard Severity	Critical (no 40 mm)
Amount of Energetic Material	1-10 pounds NEW (2.36-inch rocket, 1.6 pounds HE)
MEC Accessibility	
Intrusive Depth	Moderate
Depth Below Ground Surface	Any item < 1 foot bgs
Migration/Erosion Potential	Moderate
Public Exposure	
Ease of Access	Established trail access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Easily Portable

Current ESHA Score: D
Disposition: Further evaluation is needed—forward to the FS

8.2.22 ESHA Results for SA93-02

SA93-02 received an ESHA score of A, indicating that the site poses minimal risk to the public, but that baseline institutional controls may be needed. Table 8-23 summarizes the site characteristics relevant to the ESHA scoring.

TABLE 8-23
ESHA Results for SA93-02

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	No MEC encountered as determined from the geophysical survey and intrusive investigation conducted in 1999, as well as the 2008 instrument-aided visual reconnaissance
MEC Characteristics	
MEC Hazard Severity	None
Amount of Energetic Material	< 0.5 pound NEW
MEC Accessibility	
Intrusive Depth	Moderate (max of 2 feet)
Depth Below Ground Surface	None (no MEC)
Migration/Erosion Potential	Moderate
Public Exposure	
Ease of Access	Established trail access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Easily portable

Current ESHA Score: A
Disposition: Adak NOFA with baseline institutional controls

8.2.23 ESHA Results for SA93-03

A 100 percent geophysical survey and removal to a depth of 2 feet was conducted in 2008, therefore SA93-03 received an ESHA score of A. However, because transects rather than expansion grids were used to confirm the boundary of MEC contamination, the AOC was reassigned to the FS for further evaluation. Table 8-24 summarizes the input categories that generated the ESHA score.

TABLE 8-24
ESHA Results for SA93-03

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	100 percent geophysical survey and removal to a depth of 2 feet in 2008. Completeness issue because of use of transects instead of expansion grids along on boundary of AOC where MEC was found
MEC Characteristics	
MEC Hazard Severity	No explosive hazard
Amount of Energetic Material	< 0.5 pound NEW
MEC Accessibility	
Intrusive Depth	Moderate
Depth Below Ground Surface	No score (no MEC)
Migration/Erosion Potential	Moderate
Public Exposure	
Ease of Access	Established trail access
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Easily Portable

Current ESHA Score: A
Disposition: Further evaluation is needed—forward to the FS (to account for investigation/clearance completeness issue on boundary of AOC).

8.2.24 ESHA Results for SA93-04

SA93-04 received an ESHA score of A, indicating that the site poses minimal risk to the public, but that baseline institutional controls may be needed. Table 8-25 summarizes the site characteristics relevant to the ESHA scoring.

TABLE 8-25
ESHA Results for SA93-04

Hazard Factor	Site-Specific Characteristic
MEC Search/Removal Status	No MEC encountered as determined from the geophysical survey and intrusive investigation conducted in 1999, as well as the 2008 instrument-aided visual reconnaissance
MEC Characteristics	
MEC Hazard Severity	None
Amount of Energetic Material	< 0.5 pound NEW
MEC Accessibility	
Intrusive Depth	Moderate
Depth Below Ground Surface	None (no MEC)
Migration/Erosion Potential	Moderate
Public Exposure	
Ease of Access	Established trail access)
Current Land Use	Navy Exclusion Area
Future Land Use	Subsistence, recreation, or wildlife management
Intensity of Public Activity (energy imparted to ground)	Moderate
Portability	Low

Previous (2004) ESHA Score: Not scored
Current ESHA Score: A
Disposition: Adak NOFA with baseline institutional controls

8.3 Summary of ESHA Results and Recommendations

The following sites received an ESHA score of C or D, indicating that conditions might pose unacceptable hazards to future users of the sites and remedies to address the hazards should be evaluated in the FS:

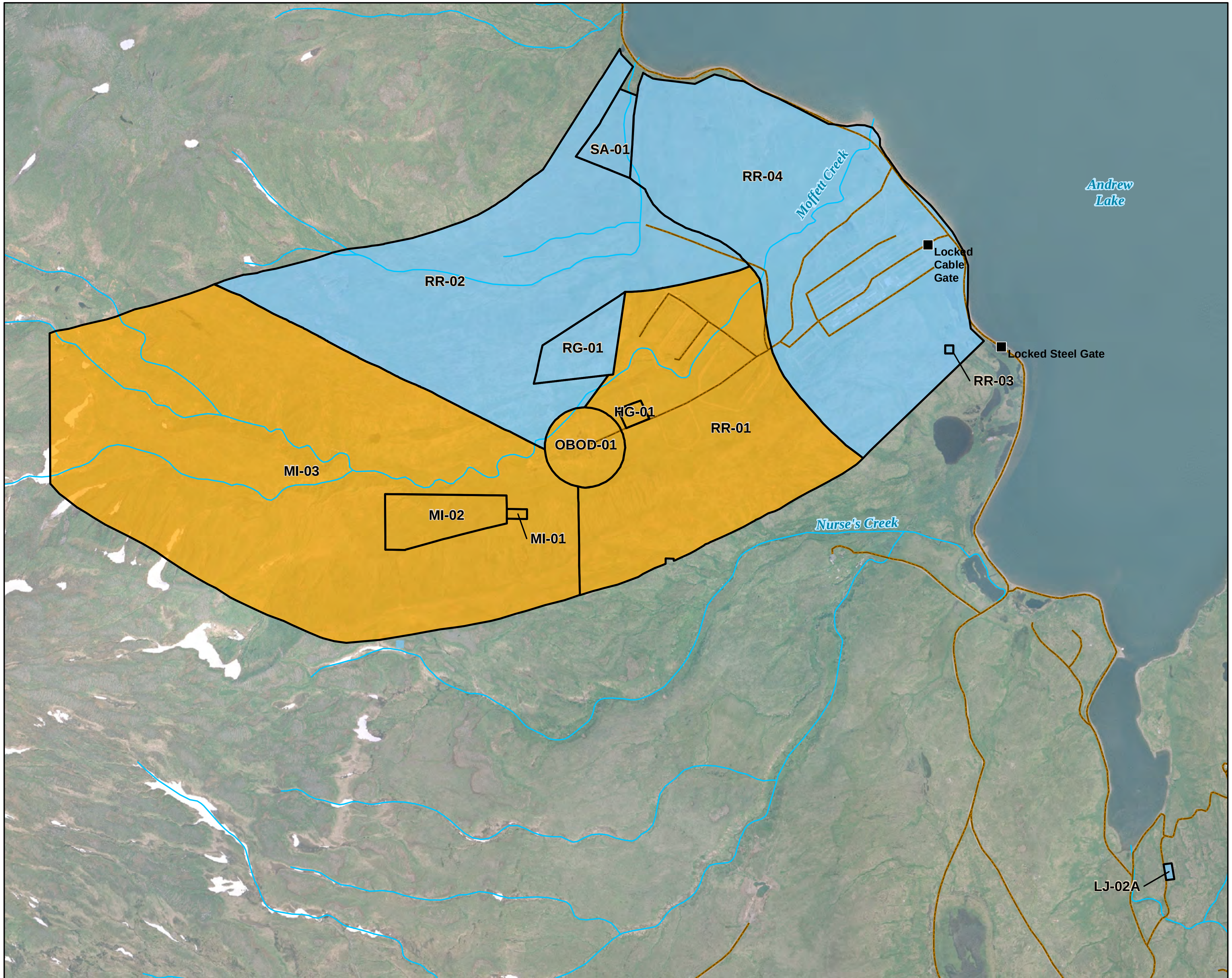
- ALDA-01
- ALSW-01
- C1-01
- HG-01
- MI-01
- MI-02
- MI-03
- OB/OD-01
- RR-01
- SA93-01
- SA93-03

The following sites received an ESHA score of A or B, indicating that active remedies are not required to mitigate possible MEC hazards, but that baseline institutional controls for may be appropriate:

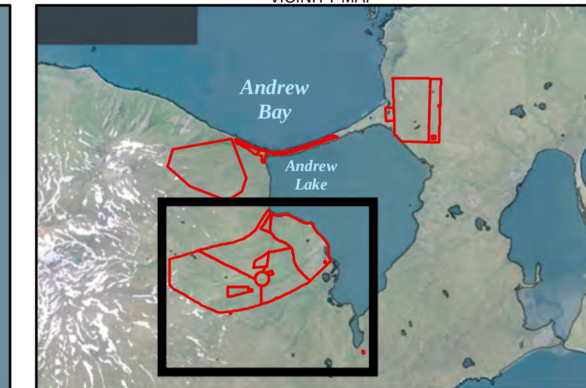
- ALDA-02
- BC-03
- JM-01
- LJ-02A
- MAG-01
- MM10D
- RG-01

- RR-02
- RR-03
- RR-04
- SA-01
- SA93-02
- SA93-04

Figures 8-2, 8-3, and 8-4 depict the current ESHA scores for AOCs at OU B-2.



VICINITY MAP



LEGEND

- Gate
- 20-ft Contour
- 100-ft Contour
- 500-ft Contour
- Stream
- Road

ESHA Score

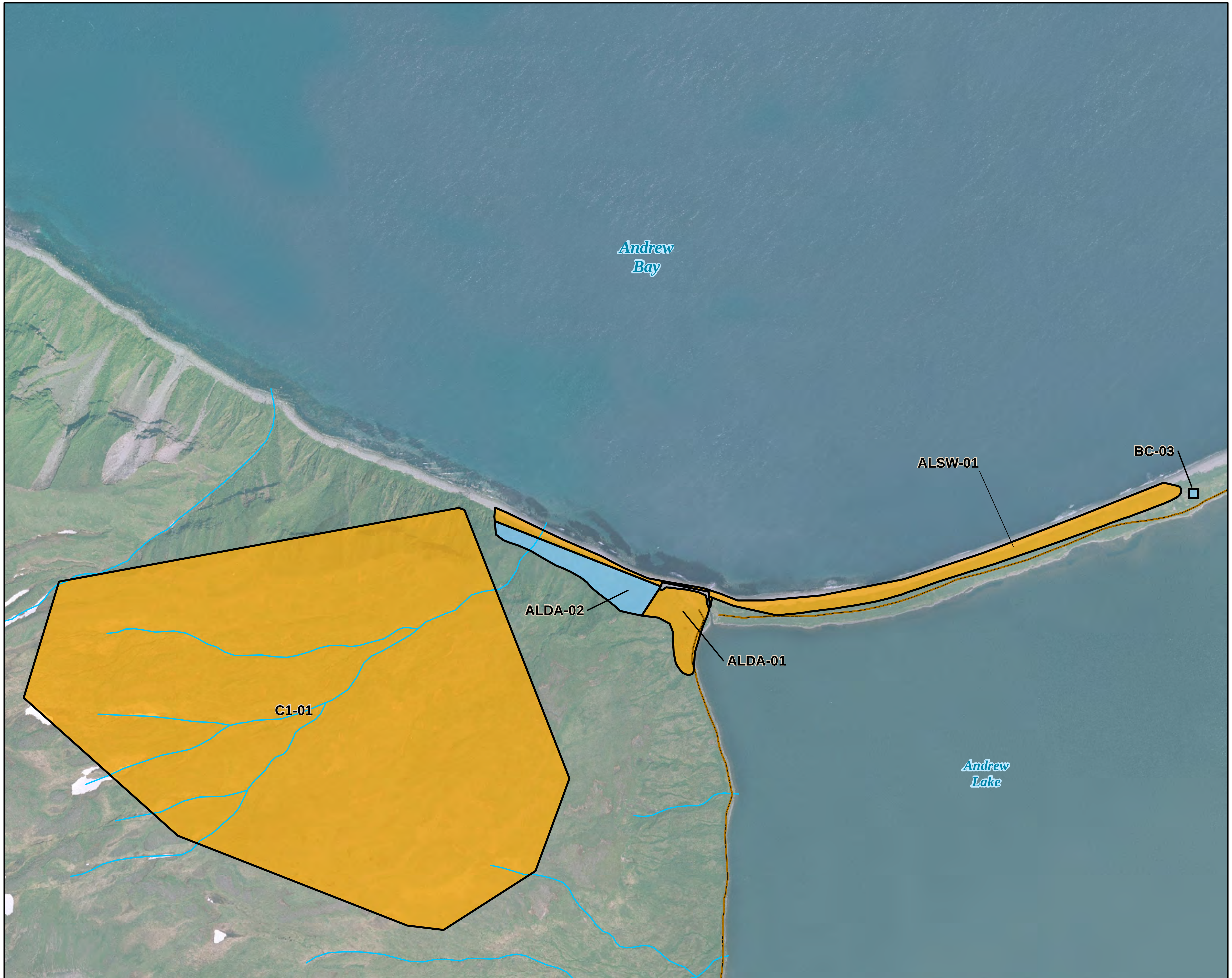
- A/B - Adak No Further Action (OU B-2 Institutional Controls May Apply)
- C/D - Further Evaluation of Remedial Alternatives in Feasibility Study

Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

N

0 650 1,300
Feet

FIGURE 8-2
Summary of ESHA Scores for OU B-2 AOCs in Range Complex at Andrew Lake
OU B-2 Remedial Investigation Report
Adak Island, Alaska



VICINITY MAP

LEGEND

- Gate
- 20-ft Contour
- 100-ft Contour
- 500-ft Contour
- Stream
- Road

ESHA Score

- A/B - Adak No Further Action (OU B-2 Institutional Controls May Apply)
- C/D - Further Evaluation of Remedial Alternatives in Feasibility Study

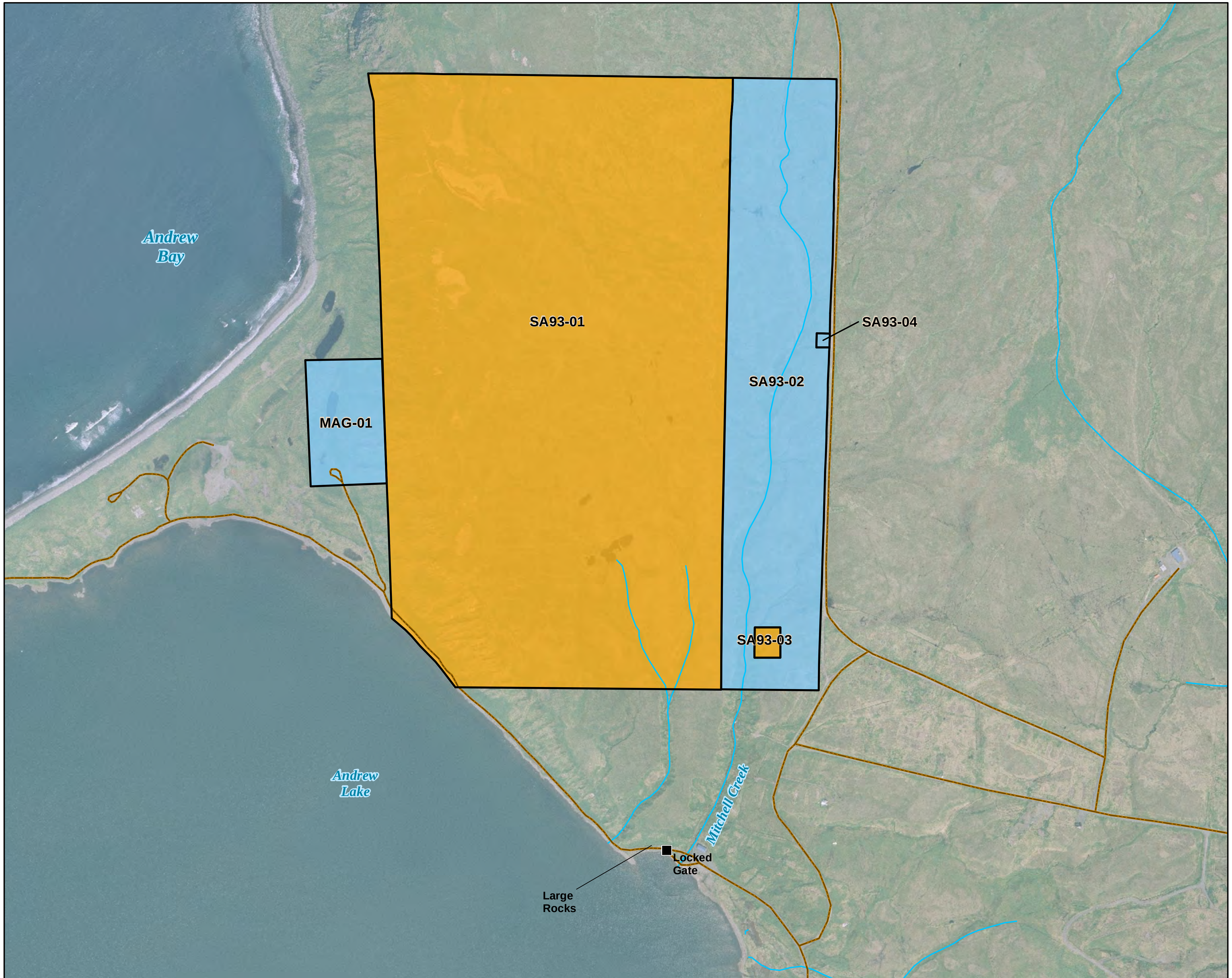
Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

N

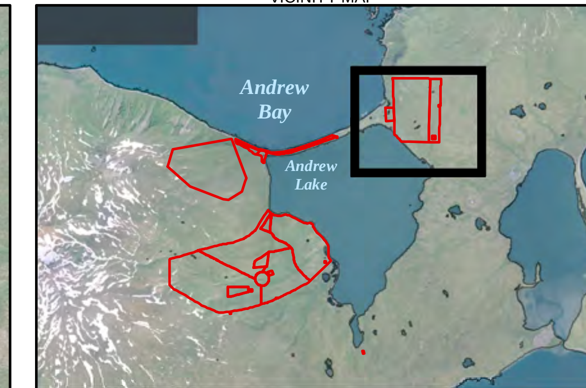
0 550 1,100
Feet

FIGURE 8-3
Summary of ESHA Scores for OU B-2 AOCs in Andrew Bay Seawall Area
OU B-2 Remedial Investigation Report
Adak Island, Alaska

CH2MHILL



VICINITY MAP



LEGEND
- Gate
- 20-ft Contour
- 100-ft Contour
- 500-ft Contour
- Stream
- Road

ESHA Score
- A/B - Adak No Further Action (OU B-2 Institutional Controls May Apply)
- C/D - Further Evaluation of Remedial Alternatives in Feasibility Study

Notes:
1. Aerial photography: 2000 fly-over (AEROMAP)

N

0 410 820
Feet

FIGURE 8-4
Summary of ESHA Scores for OU B-2 AOCs in SA93 Area
OU B-2 Remedial Investigation Report
Adak Island, Alaska

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SECTION 9

Chemical Risk Screening Assessment

This section provides the results of the human health and ecological risk screening assessments for the OU B-2 AOCs at Adak Island, Alaska. As indicated in the 2008 RI Work Plan (Tetra Tech 2008), the purpose of these risk evaluations is to determine whether there is a potential for risk to human health or the environment. The risk from past releases of MC to soil, sediment, surface water, and groundwater at the site is evaluated for the current and reasonably anticipated future land and water uses. This risk screening evaluation includes the following components:

- **Risk Assessment Approach.** Describes approaches used to evaluate chemical risk at OU B-2 AOCs (Section 9.1).
- **Selection of Chemicals of Potential Concern (COPCs).** Describes the process for identifying which data are the focus of the human and ecological risk evaluations and also identifies the constituents considered for the risk screening processes (Section 9.2).
- **Conceptual Site Model (CSM).** Provides a description of the physical setting, land uses, water beneficial uses, climate, ecological setting, and wildlife associated with the OU B-2 sites. Identifies the pathways by which human and ecological exposures could occur (Section 9.3).
- **Human Health Risk Screening Evaluation.** Provides the results of the human exposure assessment, toxicity assessment, and risk screening (Section 9.4).
- **Ecological Risk Screening Evaluation.** Provides the ecological scoping and problem formulation and the results of the ecological risk screening (Section 9.5).
- **Uncertainties and Assumptions.** Discusses the uncertainties and assumptions associated with the human and ecological screening evaluations (Section 9.6).

9.1 Risk Assessment Approach

The risk assessment approach taken at OU B-2 consisted of tiered risk screening evaluations for both human and ecological exposure. This approach is consistent with the methods described in the following ADEC, EPA, and Navy guidance documents:

- *Risk Assessment Procedures Manual Update* (ADEC 2009)
- *Ecoscoping Guidance* (ADEC 2008a)
- *Risk Assessment Guidance for Superfund (RAGS)—Volume I: Human Health Evaluation Manual, Part A* (Interim Final) (EPA 1989)
- *Risk Assessment Guidance for Superfund—Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment, Final)* (EPA 2004b)
- *Guidelines for Ecological Risk Assessment* (EPA 1998)
- *Environmental Restoration Program Manual* (Navy 2006)

The approach consists of a Tier 1 Screening Level Risk Assessment (SRA) followed by a Tier 2 Baseline Human Health Risk Assessment (BHHRA) or Baseline Ecological Risk Assessment (BERA), if required. During Tier 1, analytical data are compared to conservative risk-based benchmarks for human and ecological receptors (separate comparisons). If there are no exceedances of the benchmarks for either human or ecological receptors, then risks are acceptable and no further action is needed to address chemical risk. If exceedances are identified for either human or ecological receptors, then further evaluation (that is, Tier 2 assessments) or remedial action may be required. Completion of a Tier 2 BHHRA or BERA involves detailed assessments of exposure, toxicity assessment, and risk characterization using site-specific information and tools as appropriate. If no unacceptable risks are identified, then no further action is required to address chemical risk. If risks are identified, either collection of additional data to refine the baseline risk assessment and/or remedial action may be required.

Chemical risk assessment procedures were not detailed in the RI Work Plan; the approach for the OU B-2 risk screening evaluation was discussed during a conference call with ADEC and EPA on November 12, 2008. A memo describing the approach was sent to ADEC and EPA on December 8, 2008. Additional details about the approach (addressing comments received from ADEC in December 2008) and tables listing the proposed human health and ecological screening benchmarks were provided to ADEC on January 15, 2009.

9.2 Chemicals of Potential Concern

COPCs are those constituents that are evaluated in the risk screening process. For this risk screening evaluation, both the detected constituent concentrations and the method detection limits (MDLs) for those constituents not detected are conservatively screened to identify whether any potential for risk exists. The RI for OU B-2 focused on past releases of MC as analyzed by Method 8330 and 8330B, and of perchlorate as analyzed by Method 6850.[1] Method 8330 and 8330B list 17 different compounds. Therefore, 18 total analytes are considered COPCs.

9.2.1 Data Used in the Risk Screening Evaluation

The analytical data used in this risk screening evaluation include data from soil, sediment, surface water, and groundwater samples collected during the 2008 OU B-2 field investigation. A detailed description of the sampling and analyses is provided in Section 5. A summary of samples used in this risk screening evaluation is provided in Table 9-1, categorized by medium, sample ID, and date of collection. Analytical data for the samples are presented in Tables 5-14 and 5-16. Analytical data for sediment, surface water, and soil samples collected in the 1990s were not considered in this risk assessment because, in the case of the sediment and surface water samples, more current data (i.e., the 2008 samples) is available from the same water bodies, and, in the case of the soil samples, the impacted soils and burn pan materials were removed; consequently the results for these samples are not representative of current conditions.

9.2.1.1 Soil Data

The soil data used for this risk screening evaluation were taken both from discrete sample locations and from MIS soil samples collected during the RI. In accordance with the RI Work Plan (Tetra Tech 2008), the MIS samples were collected primarily to support the nature and extent evaluation presented in Section 6 and to determine whether discrete samples were needed at any of the AOCs. The need for discrete samples was triggered only at a single location in RG-01. Although ADEC has indicated that MIS sample results should not be used for risk assessment at this time, the MIS results for all AOCs except RG-01 are screened here to document that the MDLs were low enough to detect risk if present.

For the purposes of this risk screening evaluation, data from 28 OU B-2 soil samples were grouped and compared to risk screening benchmarks collectively. Although separate exposure areas could be distinguished based on the suspected presence of independent sources and different potentially exposed populations, the low number of detections allows for a conservative screening of site-wide maximum concentrations and MDLs. The maximum detected concentrations from the discrete samples at RG-01 are also evaluated. Soil sample locations are shown in Figures 5-1 through 5-19. The specific samples used in this assessment included 23 original and 5 field duplicate surface soil samples collected in July and October 2008. The samples are listed in Table 9-1 (note that since discrete samples were available for RG-01, the results of the MIS performed in this area were not considered).

Of the 18 constituents analyzed for, only nitroglycerin and RDX were detected in soil samples. Nitroglycerin was detected at a single MIS location at OB/OD-01 and RDX was detected in three discrete samples from the MIS decision area at RG-01-SL-01.

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1 Note: perchlorate was only a target analyte for AOCs where propellants were suspected.

TABLE 9-1
Summary of Samples Included in the Risk Screening Evaluation
OU B-2, Adak Island, Alaska

Site	Media	Sample ID	Sample Type	Date Collected
MI-02	Groundwater	MI-02-GW-01	N	7/18/2008
MI-02	Groundwater	MI-02-GW-02	N	7/17/2008
RR-04	Groundwater	RR-04-GW-01	N	7/14/2008
RR-04	Groundwater	RR-04-GW-02	N	7/14/2008
RR-04	Groundwater	RR-04-GW-03	N	7/15/2008
RR-04	Groundwater	RR-04-GW-04	N	7/15/2008
RR-04	Groundwater	RR-04-GW-05	N	7/15/2008
RR-04	Groundwater	RR-04-GW-06	N	7/16/2008
RR-04	Groundwater	RR-04-GW-103	FD	7/15/2008
ALDA-02	Sediment	ALDA-02-SD-01	N	7/5/2008
RR-01	Sediment	RR-01-SD-01	N	7/9/2008
RR-04	Sediment	RR-04-SD-01	N	7/9/2008
RR-04	Sediment	RR-04-SD-02	N	7/9/2008
RR-04	Sediment	RR-04-SD-101	FD	7/9/2008
SA93-01	Sediment	SA93-01-SD-01	N	6/28/2008
SA93-02	Sediment	SA93-02-SD-01	N	6/28/2008
ALDA-01	Soil	ALDA-01-SL-01	N	7/5/2008
ALDA-01	Soil	ALDA-01-SL-101	FD	7/5/2008
C1-01	Soil	C1-01-SL-01	N	7/12/2008
MI-01	Soil	MI-01-SL-01	N	7/16/2008
MI-01	Soil	MI-01-SL-101	FD	7/16/2008
MI-01	Soil	MI-01-SL-201	FD	7/16/2008
MI-02	Soil	MI-02-SL-01	N	7/17/2008
MI-03	Soil	MI-03-SL-01	N	7/10/2008
MI-03	Soil	MI-03-SL-02	N	7/18/2008
OBOD-01	Soil	OBOD-01-SL-01	N	7/19/2008
OBOD-01	Soil	OBOD-01-SL-02	N	7/22/2008
OBOD-01	Soil	OBOD-01-SL-03	N	7/10/2008
OBOD-01	Soil	OBOD-01-SL-103	FD	7/10/2008
OBOD-01	Soil	OBOD-01-SL-203	FD	7/10/2008
RG-01	Soil	RG-01-SL-01A	N	10/7/2008
RG-01	Soil	RG-01-SL-01B	N	10/7/2008
RG-01	Soil	RG-01-SL-01C	N	10/7/2008
RG-01	Soil	RG-01-SL-01D	N	10/7/2008
RG-01	Soil	RG-01-SL-01E	N	10/7/2008
RG-01	Soil	RG-01-SL-01F	N	10/7/2008
RG-01	Soil	RG-01-SL-01G	N	10/7/2008
RG-01	Soil	RG-01-SL-01H	N	10/7/2008
RG-01	Soil	RG-01-SL-01I	N	10/7/2008
RG-01	Soil	RG-01-SL-01J	N	10/7/2008
RR-02	Soil	RR-02-SL-01	N	7/18/2008
SA93-01	Soil	SA93-01-SL-01	N	7/4/2008
SA93-01	Soil	SA93-01-SL-02	N	7/4/2008
SA93-03	Soil	SA93-03-SL-01	N	7/11/2008
RR-04	Surface Water	RR-04-SW-01	N	7/9/2008
RR-04	Surface Water	RR-04-SW-101	FD	7/9/2008
SA93-01	Surface Water	SA93-01-SW-01	N	6/28/2008
SA93-02	Surface Water	SA93-02-SW-01	N	6/28/2008

Notes:
N = normal sample
FD = field duplicate sample

9.2.1.2 Groundwater Data

Groundwater data from a total of nine samples collected at eight sample locations in July 2008 were included in this evaluation. As was done for soil, site-wide groundwater samples were grouped and evaluated collectively. The groundwater samples were collected from temporary wells in RR-04 and groundwater seeps in MI-02. These data were used to assess potential risks from a hypothetical drinking water exposure scenario and from the exposure of wildlife and aquatic resources to groundwater potentially discharging to surface water (that is, surface water quality criteria). Note that groundwater has not been and is not anticipated to be a source of drinking water on Adak Island.

None of the 18 constituents analyzed for were detected in any of the groundwater samples.

9.2.1.3 Sediment Data

For the purposes of this risk screening evaluation, seven sediment samples collected from OU B-2 AOCs were grouped and evaluated collectively. Although separate exposure areas could be distinguished based on the suspected presence of independent sources and different potentially exposed populations, the low detections allow for a conservative screening of site-wide maximum concentrations and MDLs.

Sediment sampling locations are described in Section 5.4. The specific samples used in this assessment included six original and one field duplicate sediment samples, collected in June and July 2008. These data were used to assess the potential for risks from direct contact by humans and for ecological exposure scenarios.

None of the 18 constituents analyzed for were detected in any of the sediment samples.

9.2.1.4 Surface Water Data

Surface water data from a total of three original samples and one field duplicate were included in this evaluation. These data were collected in June and July 2008. Surface water sampling locations are described in Section 5.4. These data were used to assess potential risks from a hypothetical drinking water exposure scenario and from the exposure of wildlife and aquatic resources to surface water. Note that surface water in the OU B-2 area has not been and is not anticipated to be a source of drinking water for humans on Adak Island.

None of the 18 constituents analyzed for were detected in any of the surface water samples.

9.2.2 Exposure Point Concentrations

Exposure point concentrations (EPCs) are estimated constituent concentrations with which a receptor may come into contact, and are specific to each exposure medium. For this risk screening evaluation, EPCs were identified as the maximum detected concentrations or maximum reported MDLs, rather than being calculated by aggregating data spatially. Statistical averaging was not considered necessary because of the very limited number of detections.

9.3 Conceptual Site Model

This section provides the CSM used in the chemical risk assessment evaluations for the OU B-2 AOCs. This CSM provides a current understanding of the sources of potential contamination, physical setting, and current and future land use, and identifies potentially complete human and ecological exposure pathways at the sites. It addresses exposures that may result under current site conditions and from reasonably anticipated potential uses of the site and the surrounding areas in the future.

9.3.1 Site Background

This section provides a description of the physical setting, land uses, water beneficial uses, climate, and ecological setting and wildlife associated with the OU B-2 sites.

9.3.1.1 Physical Setting

Information about the physical setting for OU B-2 is provided in Section 2 of this report.

9.3.1.2 Characterization of Land Use

OU B-2 is a former military training area. Currently, because of hazards associated with identified MEC in the OU B-2 area, access to the OU B-2 area is restricted with locked gates, fences, and posted signs.

9.3.1.3 Water Beneficial Uses

A detailed description of the regional and local hydrogeology and the groundwater beneficial use on Adak Island is provided in Section 2.3 and 2.5. A brief description of groundwater and surface water is provided below.

Groundwater. Groundwater on Adak Island occurs predominantly in areas of high permeability, such as artificial fill or beaches, and in low-lying areas, such as deposits laid down by water or wind. Groundwater also occurs in the upland areas of coarse-grained volcanic deposits that are often characterized by fragments of rocks ejected during eruptions. Smaller amounts of groundwater also occur in localized deposits and within fractured bedrock. No aquifer or significant quantity of groundwater exists where deposits of fine-grained volcanic ash overlie bedrock. Groundwater is not used as a source of drinking water anywhere on Adak Island.

Groundwater recharge is from stream flow, originating on the upper flanks of the mountains and from direct precipitation. Groundwater discharges either directly to Andrew Lake or indirectly to Andrew Lake via Moffett Creek. Previous studies concluded that groundwater accounts for a relatively small fraction of the total discharge to Andrew Lake from the Moffett Creek Valley, with the majority of the water coming from surface water (Hart Crowser 1993). A similar relationship between surface water and groundwater discharge is likely for the Mitchell Creek Valley.

Surface Water. The surface water hydrology in the vicinity of the OU B-2 sites is characterized by several short, steep-gradient streams draining radially from Mt. Moffett and Mt. Adagdak. One major stream, Moffett Creek, drains off Mt. Moffett into the valley on the western side of Andrew Lake and runs through the valley where many of the OU B-2 sites are located. On the eastern side of Andrew Lake, a smaller drainage, Mitchell Creek, runs through the sites located in the SA93 area from north to south and drops down a steep ravine to Andrew Lake. Both streams remain active throughout the year, although the flow may fluctuate seasonally based on snowpack and snowmelt, rainfall, and surface or shallow groundwater drainage. Several small ponds or marshy areas exist seasonally or year-round in the lower elevations.

9.3.1.4 Climate

Information about the climate for Adak Island is provided in Section 2.1 of this report.

9.3.1.5 Ecological Setting

The ecological setting for Adak Island and OU B-2 are described in Section 2.7 of this report.

9.3.2 Exposure Pathway Analysis

This section describes the means by which receptors (people or animals) at or near the OU B-2 sites may come into contact with constituents in exposure media. It addresses exposures that may result under current site conditions and from reasonably anticipated potential uses of the site and the surrounding areas in the future.

An exposure pathway can be described as the physical course that a COPC takes from the point of release to a receptor. Chemical intake or route of exposure is the means by which a COPC enters a receptor. For an exposure pathway to be complete, all of the following components must be present:

- A source
- A mechanism of chemical release and transport
- An environmental transport medium
- An exposure point
- An exposure route
- A receptor or exposed population

In the absence of any one of these components, an exposure pathway is considered incomplete and, by definition, there is no risk or hazard. Figure 9-1 presents the conceptual site exposure model schematic for the site.

9.3.2.1 Contaminant Sources and Release Mechanisms

The primary sources and release mechanisms for the OU B-2 sites and their associated AOC types are as follows:

- Firing—Impact Areas, Range Safety Fans, Combat Ranges
- Dropping—Aerial Bombing Ranges and Bomb Jettison Areas
- Placement—Minefields
- Destruction—OB/OD Areas
- Disposal—Large-Scale Burials
- Loss/Abandonment—Bivouac Areas, Firing Points, Gun Emplacements, Magazines, and Transfer Points

The purpose of the risk screening is to evaluate the residual constituents that have been associated with past military operations within the OU B-2 sites.

9.3.2.2 Environmental Transport Media

Plausible mechanisms potentially transporting the COPCs from their sources to potential receptors (via environmental media) include the following (see Figure 9-1):

- Surface disturbance by human activities to ground surface
- Surface runoff (precipitation and snow-melt) to ground surface
- Subsurface disturbance by human activities to ground surface and subsurface
- Subsurface erosion to ground surface, subsurface, inland surface water sediments, and coastal beaches or near-shore sediment
- Storm surge of near-coastal waters to coastal beaches or near-shore sediment
- Tides/wave action of near-coastal waters to coastal beaches or near-shore sediment
- Percolation of MC leachate to groundwater, inland surface waters, and subsurface soil

9.3.2.3 Potentially Complete Human Exposure Pathways and Receptors

Based on the current understanding of land and groundwater use conditions at or near the OU B-2 sites, the exposure pathways considered for screening human health risks include the following:

- Incidental ingestion and dermal contact with surface and subsurface soil and sediment by current and future workers (for example, commercial and construction workers and researchers), hypothetical future residents, and future recreationalists (for example, hunters and fisherman)
- Inhalation of ambient dust particles generated by wind or maintenance activities for current and future workers, hypothetical future residents, and future recreationalists
- Ingestion and dermal contact with surface water and groundwater by current and future workers, hypothetical future residents, and future recreationalists

The hypothetical residential exposure scenario is the focus of this risk screening evaluation to determine whether land use restrictions or remedial actions may be needed to address chemical risks at the OU B-2 sites. If risk estimates under unrestricted land use assumptions are found to be lower than the residential action level, no land use controls would be deemed necessary to address chemical hazards.

9.3.2.4 Potentially Complete Ecological Exposure Pathways and Receptors

The most plausible ecological exposure pathways, based on the available habitat and food sources at the OU B-2, include the following:

- Direct contact with soil in areas containing suitable habitat for terrestrial mammals, birds, and plants
- Uptake of site-related chemicals via the food chain by higher trophic level receptors (for example, Arctic fox and bald eagle)

Conceptual Model for MEC Release

MEC Related Activity	Primary Sources AOC Type[a]	Primary Release Mechanism	Expected MEC Contamination	Secondary Source
MEC Handling and/or Storage	Storage Magazine/Ammunition Supply Points	Mishandling/Loss	DMM	Surface
		Burial	DMM	Subsurface
Weapons Training	Firing Point	Mishandling/Loss or Abandonment	DMM	Surface
		Burial	DMM	Subsurface
		Burn Pit	Incompletely burned DMM	Subsurface
	Range Buffer	Firing – Incomplete Detonation	UXO, UXO components, MPPEH	Surface
				Subsurface
		Firing – Dud Fired	UXO, UXO components	Surface
				Subsurface
		Firing – Complete Detonation	MPPEH	Surface
				Subsurface
	Target/Impact Areas	Firing – Incomplete Detonation	UXO, UXO components, MPPEH	Surface
				Subsurface
		Firing – Dud Fired	UXO, UXO components	Surface
				Subsurface
		Firing – Complete Detonation	MPPEH	Surface
				Subsurface
	Aerial Bombing Range	Dropping – Incomplete Detonation	UXO, UXO components, MPPEH	Surface
				Subsurface
		Dropping – Dud Fired	UXO, UXO components	Surface
				Subsurface
		Dropping– Complete Detonation	MPPEH	Surface
				Subsurface
Disposal Areas	Mass Burial/Landfills	Burial	DMM, UXO	Subsurface
	Open Burn/Open Detonation (OB/OD)	Kick-out/Incomplete Detonation	UXO, UXO components, MPPEH	Surface
				Subsurface
		Burning	Incompletely burned MPPEH	Surface
				Subsurface
	Offshore Disposal	Wash-up on Shore	DMM	Surface
				Near Coastal Waters

[a] Sources include only those AOC types identified at OU B-2.

Conceptual Model of Exposure Pathways

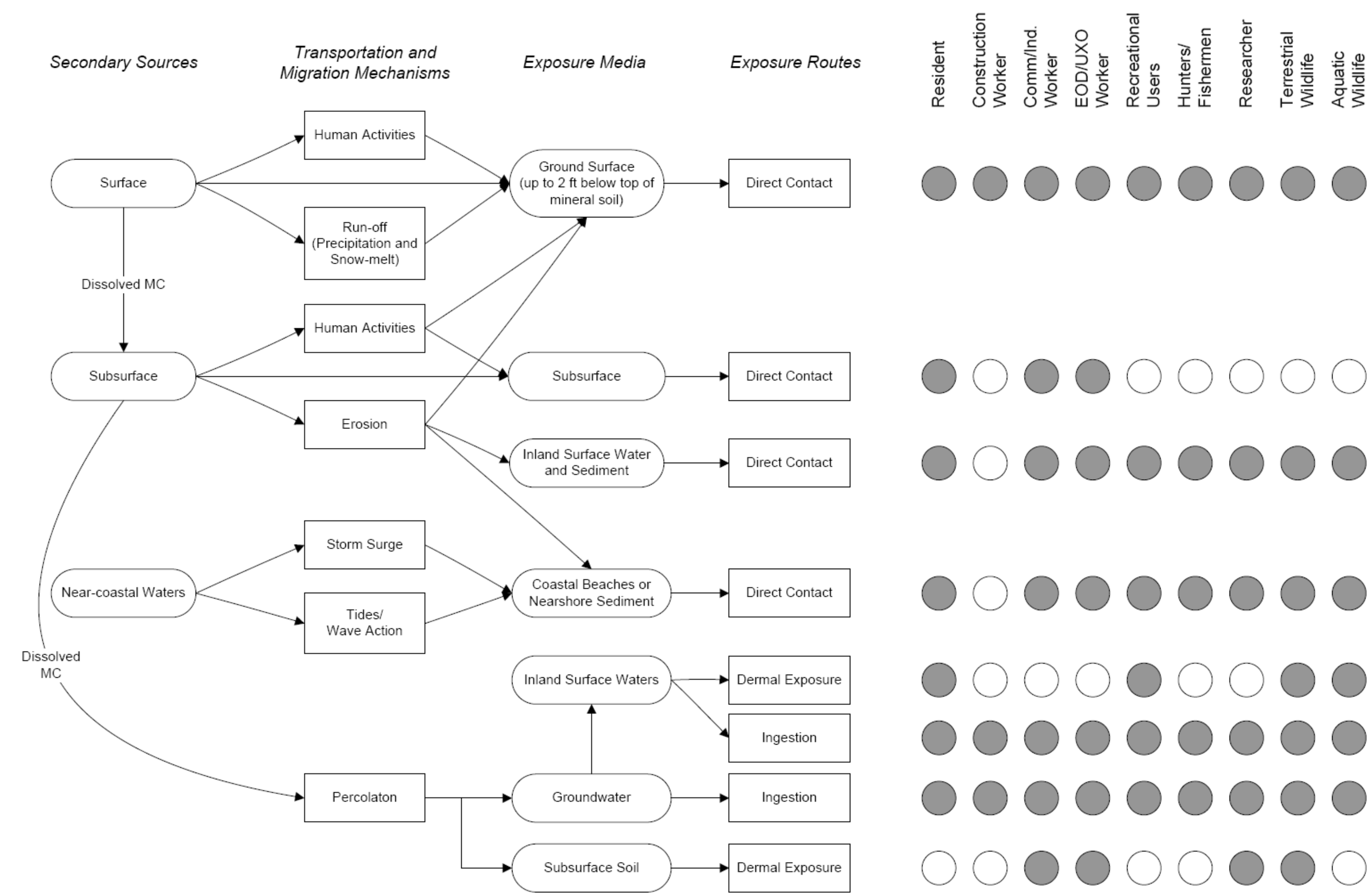

Figure 9-1
Conceptual Site Model for Chemical Risk Assessment

- Direct uptake of site-related constituents from shallow groundwater (assuming migration to surface water occurs) by aquatic and benthic organisms
- Direct contact with and ingestion of site-related constituents in shallow groundwater (assuming migration to surface water occurs) by mammals and birds
- Direct uptake of site-related constituents from surface water and sediment by aquatic and benthic organisms and plants
- Direct contact with and ingestion of site-related constituents in surface water by mammals and birds

9.4 Human Health Risk Screening Evaluation

This section presents the results of the human health screening evaluation conducted for the Adak Island OU B-2 sites, inclusive of RG-01. Based on a current understanding of the OU B-2 AOCs as outlined in the CSM (Section 9.3), conservative screening benchmarks relevant to this risk screening evaluation were used. The screening is considered conservative because it uses highly conservative assumptions, such as the following:

- Groundwater and surface water could be used as drinking water in the future
- Residential site use could occur in the future
- No attenuation of contaminants occurs in the future

The unrestricted residential and drinking water exposure scenarios were considered for the purpose of evaluating whether land use or other institutional controls could be needed. Chemicals screened out by this process therefore require no further risk assessment because they are deemed to pose no unacceptable risk.

9.4.1 Soil Results

For soil, both maximum detected concentrations and maximum reported MDLs in soil samples were compared to Method 2 Soil Cleanup Levels from recent (October 9, 2008) updates to ADEC's regulations, 18 AAC 75 *Oil and Other Hazardous Substances Pollution Control* (ADEC 2008b). These benchmarks correspond to a carcinogenic risk of one in one hundred thousand (1×10^{-5}) or a hazard quotient of 1 for non-carcinogenic chemicals, and are provided by ADEC to address the following environmental concerns for soil:

- Human health protection against ingestion and dermal exposure (direct contact)
- Human health protection against inhalation exposure (outdoor air)

Table 9-2 provides the results of the human health screening for soil. As noted previously, only three chemicals (nitroglycerin, HMX, and RDX) were detected in soil. Neither the maximum concentrations detected in soil nor the maximum MDLs exceeded screening benchmarks considered protective of human health. This indicates that even in the MIS decision area where the concentration of RDX in MIS sample RG-01-SL-01 exceeded a preliminary screening level, the presence of the chemical does not pose unacceptable risk to humans. Also provided in Table 9-2 are the results of the cumulative risk evaluation, based on summation of the chemical-specific non-cancer hazard quotients or cancer risk ratios. The cumulative risk results indicate that the hazard index (HI) value is less than 1 and the cancer risk of 2×10^{-7} is well below the ADEC regulatory threshold of 1×10^{-5}.

9.4.2 Sediment Results

For sediment, maximum reported MDLs were compared to Method 2 Soil Cleanup Levels, as with soil. Table 9-3 provides the results of the human health screening for sediment. No constituents were detected in sediment. None of the maximum MDLs exceeded screening benchmarks considered protective of human health.

TABLE 9-2
Risk Screening Evaluation Results for Soil
OU B-2, Adak Island, Alaska

Analyte	Units	Literature-Based Ecological Screening Levels[a]				Calculated (Food-web Model) Ecological Screening Levels[b]					Minimum Ecological Screening Level	Human Health Screening Levels[c]				Maximum Detect	Minimum MDL	Maximum MDL	Ecological Hazard Quotient[f]	Non-Cancer Hazard Quotient[f]	Cancer Risk Ratio[f]
		DEC Soil ERBSCs[d]	Wildlife (Diet)[e]	Plant[e]	Soil Invertebrates[e]	Tundra Vole	Arctic Fox	Sandpiper	Rock Ptarmigan	Bald Eagle		Direct Contact	Inhalation	NC	C						
1,3,5-Trinitrobenzene	mg/kg	--	9.7	--	140	0.14 (3.0)	10	--	--	--	0.14	2,300	--	x		--	0.079	0.079	0.6	0.00003	--
1,3-Dinitrobenzene	mg/kg	2,260	--	--	--	--	--	--	--	--	2,260	5.8	--	x		--	0.063	0.063	0.00003	0.01	--
2,4,6-Trinitrotoluene	mg/kg	--	5.6	30	--	14	219	7.5	14	4,006	5.6	36	--		x	--	0.083	0.083	0.01	--	0.0023
2,4-Dinitrotoluene	mg/kg	--	--	--	--	0.9	22	1.1	1.3	572	0.9	7.2	--	x		--	0.083	0.083	0.09	0.01	--
2,6-Dinitrotoluene	mg/kg	--	--	--	--	3.5	125	--	--	--	3.5	7.3	--		x	--	0.083	0.083	0.02	--	0.01
2-Amino-4,6-Dinitrotoluene	mg/kg	--	--	80	--	54	498	--	--	--	54	16	--	x		--	0.083	0.083	0.002	0.005	--
2-Nitrotoluene	mg/kg	--	--	--	--	--	--	--	--	--	--	21	--		x	--	0.066	0.066	--	--	0.003
3,5-Dinitroaniline	mg/kg	70	--	--	--	--	--	--	--	--	70	--	--			--	0.08	0.08	0.001	--	--
3-Nitrotoluene	mg/kg	--	--	--	--	--	--	--	--	--	--	1,200	--		x	--	0.071	0.071	--	--	0.00006
4-Amino-2,6-Dinitrotoluene	mg/kg	--	--	--	--	37	343	--	--	--	37	16	--	x		--	0.075	0.075	0.002	0.005	--
4-Nitrotoluene	mg/kg	--	--	--	--	--	--	--	--	--	--	290	--		x	--	0.095	0.095	--	--	0.0003
HMX	mg/kg	--	5.6	--	--	2.4	381	--	--	--	2.4	3,700	--		x	--	0.08	0.08	0.03	--	0.00002
Nitrobenzene	mg/kg	8	--	--	--	--	--	--	--	--	8.0	41	90	x		--	0.075	0.075	0.009	0.002	--
Nitroglycerin	mg/kg	--	--	--	--	29	268	--	--	--	29	240	--		x	0.52 =	0.085	0.085	0.018	--	0.0004
Perchlorate	mg/kg	--	--	--	--	26	244	695	2,200	371,947	26	58	--	x		--	0.002	0.002	0.00008	0.00003	--
PETN	mg/kg	--	--	--	--	1,613	14,840	--	--	--	1,613	--	--			--	0.579	0.579	0.0004	--	--
RDX	mg/kg	5.8	--	--	--	--	--	--	--	--	5.8	59	--		x	0.46 J	0.08	0.08	0.08	--	0.001
Tetryl	mg/kg	--	4.4	25	--	5.5	51	--	--	--	4.4	330	--	x		--	0.091	0.091	0.02	0.0003	--
																		Cumulative Risk[g]	0.9	0.03	2E-07

Notes:

a = In accordance with DEC Ecoscoping Guidance (DEC, 2008), none of the analytes are considered bioaccumulative compounds

b = NOAEL-based screening level calculated for representative site-specific receptors using conservative assumptions (e.g., 100% site use) and consistent with DEC (2005) guidance (e.g., toxicity uncertainty factors).
(value in parenthesis represents LOAEL-based benchmark)

c = State of Alaska DEC Cleanup Levels for direct contact, Over 40" from Table B1 of 18 AAC 75.341, October 9, 2008 update

d = State of Alaska Department of Environmental Conservation (DEC) Ecoscoping Guidance: March 2008

e = Nitroaromatic Munition Compounds: Environmental Effects and Screening Values by Talmage, Opresko, Maxwell, Welsh, Cretella, Reno and Daniel (1999)

f = Hazard quotients and risk ratio calculated as the maximum detect or MDL divided by the lowest ecological, non-cancer, or cancer risk screening level.

g = State of Alaska DEC Cumulative Risk Guidance: June 9, 2008 (based on Method 2 level cancer risk of 1x10-5)

C= cancer
DEC = Alaska Department of Environmental Conservation
ERBSCs = ecological risk-based screening concentrations
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
LOAEL = lowest observed adverse effect level
MDL = method detection limit
NC= noncancer
NOAEL = no observed adverse effect level
PETN = Pentaerythritol tetranitrate
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine

TABLE 9-3
Risk Screening Evaluation Results for Sediment
OU B-2, Adak Island, Alaska

Analyte	Units	Ecological Screening Levels[a,b]			Minimum Ecological Screening Level	Human Health Screening Levels[c]				Minimum MDL	Maximum MDL	Ecological Hazard Quotient[d]	Non-Cancer Hazard Quotient[d]	Cancer Risk Ratio[d]
		Benthic	Wildlife (Diet)	Plant		Direct Contact	Inhalation	NC	C					
1,3,5-Trinitrobenzene	mg/kg	0.24	9.7	--	0.24	2,300	--	x		0.079	0.13	0.5	0.00006	--
1,3-Dinitrobenzene	mg/kg	0.67	0.41	--	0.41	5.8	--	x		0.063	0.10	0.2	0.02	--
2,4,6-Trinitrotoluene	mg/kg	9.2	5.6	30	5.6	36	--		x	0.083	0.13	0.02	--	0.0036
2,4-Dinitrotoluene	mg/kg	--	--	--	--	7.2	--	x		0.083	0.13	--	0.02	--
2,6-Dinitrotoluene	mg/kg	--	--	--	--	7.3	--		x	0.083	0.13	--	--	0.02
2-Amino-4,6-Dinitrotoluene	mg/kg	--	--	80	80	16	--	x		0.083	0.13	0.002	0.008	--
2-Nitrotoluene	mg/kg	--	--	--	--	21	--		x	0.066	0.11	--	--	0.005
3,5-Dinitroaniline	mg/kg	--	--	--	--	--	--			0.08	0.13	--	--	--
3-Nitrotoluene	mg/kg	--	--	--	--	1,200	--		x	0.071	0.12	--	--	0.00010
4-Amino-2,6-Dinitrotoluene	mg/kg	--	--	--	--	16	--	x		0.075	0.12	--	0.008	--
4-Nitrotoluene	mg/kg	--	--	--	--	290	--		x	0.095	0.15	--	--	0.0005
HMX	mg/kg	0.47	5.6	--	0.5	3,700	--		x	0.08	0.13	0.3	--	0.00004
Nitrobenzene	mg/kg	--	--	--	--	41	90	x		0.075	0.12	--	0.003	--
Nitroglycerin	mg/kg	--	--	--	--	240	--		x	0.085	0.14	--	--	0.0006
Perchlorate	mg/kg	--	--	--	--	58	--	x		0.002	0.003	--	0.00006	--
PETN	mg/kg	--	--	--	--	--	--			0.579	0.94	--	--	--
RDX	mg/kg	1.3	15	100	1.3	59	--		x	0.08	0.13	0.1	--	0.002
Tetryl	mg/kg	--	4.4	25	4.4	330	--	x		0.091	0.15	0.03	0.0005	--

	Ecological Hazard Quotient	Non-Cancer Hazard Quotient	Cancer Risk Ratio
Cumulative Risk[e]	1	0.05	3E-07

Notes:
a = Nitroaromatic Munition Compounds: Environmental Effects and Screening Values by Talmage, Opresko, Maxwell, Welsh, Cretella, Reno and Daniel (1999)
b = In accordance with DEC Ecoscoping Guidance (DEC, 2008), none of the analytes are considered bioaccumulative compounds
c = State of Alaska DEC Cleanup Levels for direct contact, Over 40" from Table B1 of 18 AAC 75.341, October 9, 2008 update
d = Hazard quotients and risk ratio calculated as the maximum MDL divided by the lowest ecological, non-cancer, or cancer risk screening level.
e = State of Alaska DEC Cumulative Risk Guidance: June 9, 2008 (based on Method 2 level cancer risk of 1x10-5)

C = cancer
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
MDL = method detection limit
NC = noncancer
PETN = Pentaerythritol tetranitrate
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine

9.4.3 Surface Water Results

For surface water, maximum reported MDLs were compared to EPA's *Regional Screening Levels* (EPA 2008a). These benchmarks correspond to a carcinogenic risk of one in one million (1×10^{-6}) or a hazard quotient of 1 for non-carcinogenic chemicals, and are provided by EPA to address human health protection for ingestion, dermal, and inhalation routes of exposure. Tap water (that is, drinking water) screening levels from EPA (2008a) were used under the very conservative assumption that surface water could be used for drinking. The maximum reported MDLs were also compared to ADEC Groundwater Cleanup Levels (18 AAC 75 Table C). These benchmarks correspond to a carcinogenic risk of one in one hundred thousand (1×10^{-5}) or a hazard quotient of 1 for non-carcinogenic chemicals.

Table 9-4 provides the results of the human health screening for surface water. No constituents were detected in surface water and none of the maximum MDLs exceeded screening benchmarks considered protective of human health.

Also provided in Table 9-4 are the results of the cumulative risk evaluation, based on summation of the chemical-specific non-cancer hazard quotients or cancer risk ratios. The cumulative risk results indicate that the HI value is less than 1 and the cancer risk of 3×10^{-7} is well below the ADEC regulatory threshold of 1×10^{-5}.

9.4.4 Groundwater Results

For groundwater, maximum reported MDLs were compared to EPA's *Regional Screening Levels* (EPA 2008a), as with surface water. Tap water (that is, drinking water) screening levels were used under the very conservative assumption that groundwater could be used for drinking. The maximum reported MDLs were also compared to ADEC Groundwater Cleanup Levels (18 AAC 75 Table C). These benchmarks correspond to a carcinogenic risk of one in one hundred thousand (1×10^{-5}) or a hazard quotient of 1 for non-carcinogenic chemicals.

Table 9-5 provides the results of the human health screening for groundwater. No constituents were detected in groundwater and none of the maximum MDLs exceeded screening benchmarks considered protective of human health.

Also provided in Table 9-5 are the results of the cumulative risk evaluation, based on summation of the chemical-specific non-cancer hazard quotients or cancer risk ratios. The cumulative risk results indicate that the HI value is less than 1 and the cancer risk of 3×10^{-7} is well below the ADEC regulatory threshold of 1×10^{-5}.

9.4.5 Conclusions from the Human Health Screening Evaluation

This human health screening evaluation was conducted for MC at OU B-2 in accordance with applicable ADEC and EPA guidance. The resulting characterization of potential risk is expected to provide enough information for informed decisions at OU B-2. The primary decision for which the results of the human health screening evaluation provide input is whether to address any areas and COPCs at the site because of the potential threat of human health risk from chemical releases.

Based on the nature and extent of constituent concentrations observed during this RI, and considering current and reasonably anticipated future land use conditions, the cumulative risks posed to human health are well below the ADEC regulatory threshold of 1×10^{-5} (for carcinogens) and 1 (for non-carcinogens) for all exposure scenarios, and additional risk assessments or remedial actions are not required to address human health risk.

TABLE 9-4
Risk Screening Evaluation Results for Surface Water
OU B-2, Adak Island, Alaska

Analyte	Units	Ecological Screening Levels[a]				Minimum Ecological Screening Level	Human Health Screening Levels					Minimum MDL	Maximum MDL	Ecological Hazard Quotient[d]	Non-Cancer Hazard Quotient[d]	Cancer Risk Ratio[d]
		Aquatic	Source	Wildlife Drinking Water[b]	Fish Consumption[c]		ADEC Table C[j]	Tapwater	NC	C	Source[k]					
1,3,5-Trinitrobenzene	µg/L	120	e	11,000	2,100	120	1,100	1,100	x		h	0.13	0.13	0.001	0.0001	--
1,3-Dinitrobenzene	µg/L	26	f	490	60	26	3.7	3.7	x		h	0.131	0.131	0.005	0.04	--
2,4,6-Trinitrotoluene	µg/L	90	e	6,600	400	90	18	2.2		x	h	0.133	0.133	0.001	--	0.06
2,4-Dinitrotoluene	µg/L	23	f	--	--	23	1.3	73	x		h	0.125	0.125	0.005	0.002	--
2,6-Dinitrotoluene	µg/L	60	f	--	--	60	1.3	37		x	h	0.125	0.125	0.002	--	0.003
2-Amino-4,6-Dinitrotoluene	µg/L	1,480	g	--	--	1,480	7.3	73	x		h	0.125	0.125	0.00008	0.002	--
2-Nitrotoluene	µg/L	880	g	--	--	880	3.7	370		x	h	0.126	0.126	0.0001	--	0.0003
3,5-Dinitroaniline	µg/L	650	e	--	--	650		--			--	0.13	0.13	0.0002	--	--
3-Nitrotoluene	µg/L	750	g	--	--	750	730	120		x	i	0.133	0.133	0.0002	--	0.001
4-Amino-2,6-Dinitrotoluene	µg/L	--	--	--	--	--	7.3	73	x		h	0.1	0.1	--	0.001	--
4-Nitrotoluene	µg/L	1,900	g	--	--	1,900	50	4.2		x	h	0.133	0.133	0.00007	--	0.03
HMX	µg/L	>3,300	e	6,600	5,700	3,300	1,800	1,800		x	h	0.115	0.115	0.00003	--	0.00006
Nitrobenzene	µg/L	270	f	--	--	270	18	3.4	x		h	0.126	0.126	0.0005	0.04	--
Nitroglycerin	µg/L	138	g	--	--	138	50	3.7		x	h	0.13	0.13	0.0009	--	0.04
Perchlorate	µg/L	--	--	--	--	--		26	x		h	0.2	0.2	--	0.008	--
PETN	µg/L	85,000	g	--	--	85,000		--			--	0.607	0.607	0.000007	--	--
RDX	µg/L	4,900	e	17,000	6,700	4,900	7.7	0.61		x	h	0.123	0.123	0.00003	--	0.2
Tetryl	µg/L	--	--	5,200	400	400	150	150	x		h	0.133	0.133	0.0003	0.0009	--
												Cumulative Risk[j]		0.02	0.09	3E-07

Notes:
a = In accordance with DEC Ecoscoping Guidance (DEC, 2008), none of the analytes are considered bioaccumulative compounds
b = Nitroaromatic Munition Compounds: Environmental Effects and Screening Values by Talmage, Opresko, Maxwell, Welsh, Cretella, Reno and Daniel (1999); wildlife water consumption
c = Talmage et al., 1999; piscivorous wildlife consumption of fish
d = Hazard quotients and risk ratio calculated as the maximum MDL divided by the lowest ecological, non-cancer, or cancer risk tapwater screening level.
e = Talmage et al., 1999; aquatic life protection
f = State of Alaska Department of Environmental Conservation (DEC) Ecoscoping Guidance: March 2008
g = Ecological Screening Benchmarks - EPA Region 6: September 28, 2006
h = EPA Regional Screening Levels for Chemical Contaminants at Superfund Sites: August, 2008
i = EPA Region 9 PRG Table: October 2004
j = ADEC Table C (18 AAC 75) values for carcinogens correspond to a carcinogenic risk of 1×10^{-5}
k = Source of tapwater screening value used in non-cancer hazard quotient and cancer risk ratio calculations

C = cancer
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
MDL = method detection limit
NC = noncancer
PETN = Pentaerythritol tetranitrate
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine

TABLE 9-5
Risk Screening Evaluation Results for Groundwater
OU B-2, Adak Island, Alaska

Analyte	Units	Ecological Screening Levels[a]				Minimum Ecological Screening Level	Human Health Screening Levels					Minimum MDL	Maximum MDL	Ecological Hazard Quotient[d]	Non-Cancer Hazard Quotient[d]	Cancer Risk Ratio[d]
		Aquatic	Source	Wildlife Drinking Water[b]	Fish Consumption[c]		ADEC Table C[j]	Tapwater	NC	C	Source[k]					
1,3,5-Trinitrobenzene	µg/L	120	e	11,000	2,100	120	1,100	1,100	x		h	0.13	0.13	0.001	0.0001	--
1,3-Dinitrobenzene	µg/L	26	f	490	60	26	3.7	3.7	x		h	0.131	0.131	0.005	0.04	--
2,4,6-Trinitrotoluene	µg/L	90	e	6,600	400	90	18	2.2		x	h	0.133	0.133	0.001	--	0.06
2,4-Dinitrotoluene	µg/L	23	f	--	--	23	1.3	73	x		h	0.125	0.125	0.005	0.002	--
2,6-Dinitrotoluene	µg/L	60	f	--	--	60	1.3	37		x	h	0.125	0.125	0.002	--	0.003
2-Amino-4,6-Dinitrotoluene	µg/L	1,480	g	--	--	1,480	7.3	73	x		h	0.125	0.125	0.00008	0.002	--
2-Nitrotoluene	µg/L	880	g	--	--	880	3.7	370		x	h	0.126	0.126	0.0001	--	0.0003
3,5-Dinitroaniline	µg/L	650	e	--	--	650		--			--	0.13	0.13	0.0002	--	--
3-Nitrotoluene	µg/L	750	g	--	--	750	730	120		x	i	0.133	0.133	0.0002	--	0.001
4-Amino-2,6-Dinitrotoluene	µg/L	--	--	--	--	--	7.3	73	x		h	0.1	0.1	--	0.001	--
4-Nitrotoluene	µg/L	1,900	g	--	--	1,900	50	4.2		x	h	0.133	0.133	0.00007	--	0.03
HMX	µg/L	>3,300	e	6,600	5,700	3,300	1,800	1,800		x	h	0.115	0.115	0.00003	--	0.00006
Nitrobenzene	µg/L	270	f	--	--	270	18	3.4	x		h	0.126	0.126	0.0005	0.04	--
Nitroglycerin	µg/L	138	g	--	--	138	50	3.7		x	h	0.13	0.13	0.0009	--	0.04
Perchlorate	µg/L	--	--	--	--	--		26	x		h	0.2	0.2	--	0.008	--
PETN	µg/L	85,000	g	--	--	85,000		--			--	0.607	0.607	0.000007	--	--
RDX	µg/L	4,900	e	17,000	6,700	4,900	7.7	0.61		x	h	0.123	0.123	0.00003	--	0.2
Tetryl	µg/L	--	--	5,200	400	400	150	150	x		h	0.133	0.133	0.0003	0.0009	--
												Cumulative Risk[j]		0.02	0.09	3E-07

Notes:
a = In accordance with DEC Ecoscoping Guidance (DEC, 2008), none of the analytes are considered bioaccumulative compounds
b = Nitroaromatic Munition Compounds: Environmental Effects and Screening Values by Talmage, Opresko, Maxwell, Welsh, Cretella, Reno and Daniel (1999); wildlife water consumption
c = Talmage et al., 1999; piscivorous wildlife consumption of fish
d = Hazard quotients and risk ratio calculated as the maximum MDL divided by the lowest ecological, non-cancer, or cancer risk screening level.
e = Talmage et al., 1999; aquatic life protection
f = State of Alaska Department of Environmental Conservation (DEC) Ecoscoping Guidance: March 2008
g = Ecological Screening Benchmarks - EPA Region 6: September 28, 2006
h = EPA Regional Screening Levels for Chemical Contaminants at Superfund Sites: August, 2008
i = EPA Region 9 PRG Table: October 2004
j = ADEC Table C (18 AAC 75) values for carcinogens correspond to a carcinogenic risk of $1x10^{-5}$
k = Source of tapwater screening value used in non-cancer hazard quotient and cancer risk ratio calculations

C = cancer
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
MDL = method detection limit
NC = noncancer
PETN = Pentaerythritol tetranitrate
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine

9.4.6 Ecological Risk Screening Evaluation

This subsection provides the methodology and results of the ecological screening evaluation for the OU B-2 AOCs. The objectives of this ecological screening evaluation are to identify the potential for ecological exposures to site-related chemicals and to identify the likelihood of adverse impacts on potential receptors. As recommended by ADEC (2005 and 2008a), Navy (2006), and EPA (1997a and 1998), the ecological screening evaluation has been conducted using a tiered approach. In accordance with ADEC guidance (2005), a decision point occurs after each tier where one of the following three decisions is made:

- There are adequate data to conclude that ecological risks are negligible and there is no need for remediation based on ecological risk.
- The information is not adequate to make a decision at this point and the ecological risk assessment process should continue.
- The information indicates potential for adverse ecological effects, and either a more thorough assessment or remediation based on ecological risk is warranted.

The first and second steps of the ecological risk assessment process are conducted as part of the Ecological Scoping Evaluation (ADEC 2008a). Step 1 is a qualitative determination of whether there is any reason to believe that ecological receptors and/or exposure pathways are present or potentially present at or near the facility. The primary purpose of Step 1 is to identify those areas that are obviously devoid of ecological exposures and that can be quickly eliminated from further evaluation. For those areas where ecological receptors are likely exposed to site-related constituents, Step 2 compares site-related chemical concentrations with conservative screening benchmarks provided by ADEC (2008a).

Step 3 in the ADEC process is analogous to the screening-level ecological risk assessment in EPA guidance (1997b). This step includes abbreviated forms of the basic elements of risk assessment: 1) preliminary problem formulation, 2) analysis of exposure and effects, 3) risk characterization, and 4) uncertainty evaluation.

The last step (Step 4), Baseline Ecological Risk Assessment, is only required when sites are complex or when the scoping and screening has indicated a potential for risk. Based on the results of Step 3 provided in this report, Step 4 is considered unnecessary for the OU B-2 AOCs.

9.4.7 Steps 1 and 2—Ecological Scoping Evaluation

The ecological scoping (ecoscoping) process determines whether a screening-level ecological risk assessment or a full baseline ecological risk assessment is warranted. During the scoping process, the following factors are evaluated:

- Direct visual impacts or signs of acute toxicity
- Receptor-pathway interactions
- Quality and availability of habitat
- Quantity of contaminated media
- Toxicity benchmark levels

The Ecoscoping Evaluation was conducted in accordance with ADEC (2008a). The RI fieldwork conducted in the summer of 2008 and the *Remedial Investigation Work Plan* (Tetra Tech 2008) provided the basis for the information used to conduct the Ecoscoping Evaluation.

9.4.7.1 Step 1—Ecoscoping Results

The Ecoscoping Form for the OU B-2 AOCs is provided in Appendix L. Relevant information on the ecological setting (such as habitat, wildlife, threatened and endangered species, and land use) was provided as part of the CSM (Section 9.3) and in Section 2. Considering these factors along with the information obtained during the development of the RI, the Ecoscoping Evaluation indicated that high quality habitat exists on Adak Island, although low diversity of vegetation is present. As identified in Section 9.3.2.4, potentially complete ecological exposure pathways exist for both aquatic and terrestrial habitats at and surrounding the OU B-2 AOCs. The

Ecoscoping Form identified potentially threatened and endangered species that could use the OU B-2 sites or surroundings areas. As described in Section 9.3.1.5, threatened and endangered species using Adak Island include the endangered short-tailed albatross, Steller's sea lion, Aleutian shield fern, and threatened northern sea otter, although none of these species is expected to frequent the OU B-2 AOCs.

The Ecoscoping Evaluation also indicated that, based on the criteria for bioaccumulative compounds described in ADEC guidance (ADEC 2008a), none of the COPCs is considered bioaccumulative.

9.4.7.2 Step 2—Preliminary Screening

The preliminary screening process is intended to screen COPC concentrations per screening levels provided in ADEC's guidance (2008a). ADEC (2005) notes that these are "very conservative benchmarks" that represent the lowest available benchmark for each medium. For the COPCs at OU B-2, few benchmarks were provided by the ADEC guidance. Considering this, the preliminary screening step could not be used to determine if ecological risks are negligible or whether OU B-2 areas could exit the ecological risk process. Instead, COPCs were carried forward to Step 3 where additional screening benchmarks can be added to determine the potential for ecological risk.

9.4.8 Step 3—Screening-Level Ecological Risk Evaluation

As noted above, the results of the Ecoscoping Evaluation identified potentially complete ecological exposure pathways in the vicinity of the OU B-2 sites; Step 3 is provided to determine whether site-related constituents could pose unacceptable risks to wildlife and aquatic resources using habitats in the area. Step 3 includes a screening of detected compounds and MDLs (for non-detected chemicals) in relevant exposure media with applicable ecological risk benchmarks. COPCs with site media concentrations exceeding ecological screening values would be carried forward for further evaluation as part of the fourth step of ADEC's process, Baseline Ecological Risk Assessment.

The subsections below present the findings of the Step 3 Screening-Level Ecological Risk Evaluation at OU B-2 sites.

9.4.8.1 Preliminary Problem Formulation

Preliminary problem formulation identifies ecological resources and attributes at the site, as well as the stressors that could affect these attributes. Per ADEC guidance (2005), problem formulation activities culminate in the generation of three elements: 1) a CSM (Section 9.3), 2) developed assessment endpoints (Section 9.5.2.1), and 3) identified measures of effect (Section 9.5.2.1). The information used to develop the problem formulation at OU B-2 is discussed in the following subsections.

Identification of Habitats and Ecological Receptors. Habitat and potential terrestrial wildlife and aquatic life are described as part of the conceptual site exposure model in Section 9.3.1.5.

Identification of Site Stressors and Contaminants of Interest. Any physical, chemical, or biological entity that can elicit an adverse response at the site is known as a stressor. At the OU B-2, the potential site-related stressors consist primarily of chemicals released to site media during historical military operations. On the basis of the history of the site activities, the primary COPCs identified are munitions-related compounds. COPCs evaluated in this ecological screening evaluation are listed in Tables 9-2 through 9-5.

Selection of Assessment Endpoints and Measures of Effect. One outcome of Step 3 is the identification of potential assessment endpoints, which are the ecological resources identified as important to the overall health to the ecosystem or to a particularly valuable component of the ecosystem. Assessment endpoints frequently cannot be directly measured because they tend to correspond to complex ecosystem attributes. Because of this, the ecological screening evaluation identifies other related measures that serve as representations or surrogates of each assessment endpoint. These measures are called "measures of effect" and "measures of exposure" (EPA 1998). The strength of the relationships between these measures and their corresponding assessment endpoints is critical to the identification of ecological adversity. For this ecological screening evaluation, these measures are defined as follows:

- Measures of exposure are quantitative or qualitative indicators of a constituent's occurrence and movement in the environment in a way that results in contact with the assessment endpoint. For example, chemical concentrations detected in surface soil at OU B-2 AOCs serve as measures of exposure to visiting or resident wildlife.
- Measures of effect are measurable adverse changes in an attribute of an assessment endpoint (or its surrogate) in response to a chemical to which it is exposed. For example, ADEC has published soil ERBSCs (ADEC 2008a) for avian and mammalian species representative of those occurring in Alaska that serve as conservative indicators of when wildlife may be adversely affected.

The candidate assessment endpoints identified for the OU B-2 AOCs, and the corresponding measures of exposure and effect, are summarized in Table 9-6. More information about endpoint development is provided in Appendix L.

TABLE 9-6
Summary of Measures of Exposure and Effect for Assessment Endpoints
OU B-2, Adak Island, Alaska

Assessment Endpoint Functional Group	Assessment Endpoint	Measure of Exposure	Measure of Effect
Terrestrial Wildlife (Birds and Mammals)	Survival and health of birds and mammals using suitable habitat and potentially exposed to constituents in soil, sediment, surface water, and prey items	Measured constituent levels in soil, sediment, surface water, and groundwater	Screening benchmarks for birds and mammals; site-specific benchmarks for birds and mammals; surface water screening benchmarks
Aquatic and Benthic Organisms	Survival and health of populations of aquatic and benthic organisms potentially exposed to constituents in surface water and sediment	Measured constituent levels in sediment, surface water, and groundwater	Surface water screening benchmarks for aquatic organisms; sediment screening benchmarks for benthic organisms
Vegetation	Survival and health of aquatic and upland plants potentially exposed to constituents in sediment and soil	Measured constituent levels in sediment and soil	Screening benchmarks for plants

9.4.8.2 Ecological Risk Screening Results

Considering the potentially complete pathways identified in Section 9.3.2.4, this Step 3 Screening-Level Ecological Risk Evaluation evaluates COPCs detected in each OU B-2 AOC where suitable habitat exists and includes groundwater potentially migrating offsite to the adjacent freshwater bodies. As recommended in ADEC guidance (ADEC 2005), soil, sediment, surface water, and groundwater[2] concentrations are directly compared with levels believed to be nontoxic. The results are described in the following subsections.

Soil Screening Results. For soil, individual sample data (that is, maximum detected values and MDLs) are directly compared with soil benchmarks protective of mammals, birds, plants, and invertebrates provided by the following sources in order of preference:

- Ecoscoping Guidance (ADEC 2008a)
- Nitroaromatic Munition Compounds: Environmental Effects and Screening Values (Talmage et al. 1999)
- *Ecological Screening Benchmarks*, which presents ecological benchmarks (EBs) calculated for site-specific endpoint species (EPA 2006)

2 Groundwater is conservatively evaluated using surface water screening level values and without attenuation factors applied.

Ecological benchmarks for site-specific receptors were calculated to fill in gaps where screening values are not readily available and to ground-truth the other “generic” benchmarks. Site-specific EBs for the bald eagle, rock ptarmigan, rock sandpiper, Arctic fox, and tundra vole were calculated. The methodology used to calculate these site-specific EBs is presented in Appendix L. The EBs were developed using highly conservative assumptions such as 1) that a completely suitable habitat is provided throughout the AOCs, 2) no attenuation of contaminants occurs in the future, 3) wildlife forage exclusively at OU B-2 sites. Chemicals screened out during Step 3 are discussed, but no further risk evaluation is needed because they pose minimal risk (if any).

Table 9-2 provides comparisons of maximum soil concentrations and maximum MDLs with the applicable screening benchmarks described above. No concentrations detected in soil exceeded screening benchmarks considered protective of birds, mammals, terrestrial invertebrates, and plants. No MDLs exceeded these screening benchmarks.

Also provided in Table 9-2 are the results of the cumulative risk evaluation, based on summation of the chemical-specific hazard quotients for all constituents. The cumulative risk results[3] indicate that the HI value does not exceed 1.

Sediment Screening Results. For sediment, individual sample data (that is, maximum detected values and MDLs) are directly compared with sediment benchmarks protective of benthic macroinvertebrates, wildlife, and plants provided in *Nitroaromatic Munition Compounds: Environmental Effects and Screening Values* (Talmage et al. 1999).

Table 9-3 provides comparisons of maximum MDLs with the applicable screening benchmarks described above. No constituents were detected in sediment. No MDLs exceeded sediment screening benchmarks considered protective of birds, mammals, benthic macroinvertebrates, and plants.

Also provided in Table 9-3 are the results of the cumulative risk evaluation, based on summation of the chemical-specific hazard quotients for all constituents. The cumulative risk results indicate that the HI value does not exceed 1.

Surface Water Screening Results. For surface water, individual sample data (that is, maximum detected values and MDLs) are directly compared with freshwater benchmarks protective of aquatic resources provided by the following sources in order of preference:

- *Ecoscoping Guidance* (ADEC 2008a)
- *Nitroaromatic Munition Compounds: Environmental Effects and Screening Values (Talmage et al. 1999)*
- *Ecological Screening Benchmarks* (EPA 2006)

Table 9-4 provides comparisons of maximum surface water MDLs with the applicable screening benchmarks described above. No constituents were detected in surface water and no MDLs exceeded surface water screening benchmarks considered protective of birds, mammals, aquatic invertebrates, and fish.

Also provided in Table 9-4 are the results of the cumulative risk evaluation, based on summation of the chemical-specific hazard quotients for all constituents. The cumulative risk results indicate that the HI value does not exceed 1.

Groundwater Screening Results. For groundwater, individual sample data (that is, maximum detected values and MDLs) are directly compared with freshwater benchmarks protective of aquatic resources provided by the following sources in order of preference:

- *Ecoscoping Guidance* (ADEC 2008a)
- *Nitroaromatic Munition Compounds: Environmental Effects and Screening Values* (Talmage et al. 1999)
- *Ecological Screening Benchmarks* (EPA 2006)

[3] Note the cumulative risk screening is very conservative because it considers the lowest ecological screening level, regardless of endpoint species.

Table 9-5 provides comparisons of maximum groundwater MDLs with the applicable screening benchmarks described above. No constituents were detected in groundwater and no MDLs exceeded groundwater screening benchmarks considered protective of birds, mammals, aquatic invertebrates, and fish.

Also provided in Table 9-5 are the results of the cumulative risk evaluation, based on summation of the chemical-specific hazard quotients for all constituents. The cumulative risk results indicate that the HI value does not exceed 1.

9.4.9 Conclusions from the Ecological Screening

This ecological screening evaluation for the OU B-2 AOCs was conducted in accordance with EPA, ADEC, and Navy guidance, focusing on the site-related COPCs, receptors, and areas where ecological exposures could be expected. The resulting characterization is expected to provide enough information for informed decisions at the OU B-2. The primary decision for which the results of the ecological screening evaluation provide input is whether to address any areas and COPCs at the site because of the potential threat of ecological risk.

The risk to wildlife, vegetation, and aquatic resources potentially exposed to soil, sediment, surface water, and groundwater is considered low. This conclusion was drawn on the basis of considering that concentrations of COPCs detected in site media are not considered high enough to pose unacceptable risk to potential ecological receptors.

9.5 Uncertainties and Assumptions

Characterization of human health and ecological risks requires that numerical estimates of risks be accompanied by a discussion of the uncertainties inherent in the assumptions used to estimate those risks. Uncertainties in risk screening evaluation methods may result either in understating or overstating the risks. The latter is likely the case when health-conservative assumptions are used to characterize risk. This is particularly true of risk screening evaluations like those conducted for the OU B-2 area. In general, risk estimates are subject to uncertainty from a variety of sources, including the following:

- Sampling, analysis, and data evaluation
- Fate and transport estimation
- Exposure estimation
- Toxicological data

General and site-specific uncertainties, as well as their potential effects on the results of the risk screening evaluation, are discussed below.

9.5.1 Sampling, Analysis, and Data Evaluation

Uncertainty associated with sampling and analysis includes the inherent variability (standard error) in the analysis, representativeness of the samples, sampling errors, and heterogeneity of the sample matrix. The QA/QC program typically used in site investigations serves to reduce these errors, but it cannot eliminate all errors associated with sampling and analysis. The degree to which sample collection and analyses reflect real exposure concentrations partly determines the reliability of the risk estimates. Sample data used for the risk screening evaluation were often targeted close to suspected source areas. Because human and ecological exposures are not likely to be limited to these potentially higher concentration areas, risk estimates may be biased high.

9.5.2 Fate and Transport Estimation

This risk screening evaluation makes simplifying assumptions about environmental fate and transport of contaminants; specifically, it assumes that no chemical loss or transformation has occurred since the sampling data were collected. It also assumes that the constituent concentrations detected in site media remain constant during the assessed exposure duration. Because of this, the EPCs used for assessing risk in this report are likely higher than the actual concentrations that most humans and wildlife may be exposed to at the OU B-2 AOCs. In cases where natural attenuation or other degradation processes are high, the analytical data chosen to represent COPC exposure concentrations may overstate actual long-term exposure levels.

9.5.3 Exposure Estimation

The estimation of exposure requires many assumptions to describe potential exposure situations. There are uncertainties regarding the likelihood of exposure, the concentration of contaminants at exposure points, and the time period of exposure. The assumptions used tend to simplify and approximate future site conditions and may over- or underestimate the actual risks. In general, these assumptions are intended to be conservative and yield an overestimate of the true risk or hazard. Exposure parameters selected to develop ecological screening benchmarks are intended to be conservative and likely overstate the actual risks to ecological receptors. Quantitative measures of dermal exposure to ecological receptors are not available and are not part of the development of the wildlife screening benchmarks. Therefore, dermal exposures of wildlife could not be evaluated.

9.5.4 Toxicological Data

Uncertainties in toxicological data can also influence the reliability of risk management decisions. The toxicity values used for quantifying risk in this screening evaluation have varying levels of confidence that affect the usefulness of the resulting risk estimates. Sources of uncertainty associated with toxicity values used in the toxicity assessment include the following:

- Extrapolation of dose-response data derived from high dose exposures in laboratory animals to predict adverse health effects that may occur at much lower exposure levels seen in the environment
- Extrapolation of dose-response data derived from short-term tests to predict effects of chronic exposures
- Extrapolation of dose-response data derived from animal studies to predict effects on humans
- Extrapolation of dose-response data from homogeneous populations to predict effects on the general population

The levels of uncertainty associated with the toxicity factors used to develop screening benchmarks are expressed as uncertainty factors and modifying factors, and are provided in EPA's integrated risk information system (IRIS) (EPA 2008b) or other sources. For those chemicals suspected of having cancer effects, uncertainty is in part expressed in terms of EPA's weight-of-evidence classification. As previously stated, models that extrapolate toxicological data between species, doses, and/or exposure duration also contribute to uncertainty.

Dermal exposures are different from oral exposures because not all of a constituent that comes into contact with a person's skin travels across the various layers of epidermal tissue, as indicated by a skin permeability factor, and because the toxic effects produced from this route of exposure may not be the same as when the constituent is ingested. In lieu of available toxicity values for the dermal route, the screening benchmarks in this human health screening evaluation use oral toxicity values to estimate the effects of dermally available constituents. This may result in an underestimate or an overestimate of risks, depending on whether a constituent is more or less toxic by the dermal route versus by ingestion.

For many contaminants, data on toxicity to avian and mammalian wildlife are limited. In addition, the usefulness of existing toxicity information in assessing ecological impacts is constrained by several factors. Most toxicity information is generated by laboratory studies with selected test species. The screening benchmarks used for this assessment have varying levels of confidence that will affect how useful the resulting risk estimates are. Because some of the constituents detected in site media did not have available screening benchmarks from which to screen risks, these constituents could not be evaluated. However, most of the constituents that have no available toxicity data are considered less toxic, because most of the toxicological literature focuses on those constituents considered more toxic to ecological receptors.

SECTION 10

Conclusions and Recommendations

This section presents the conclusions and recommendations for the OU B-2 RI, identifies recommended remedial action areas (RAAs), and provides a preliminary review of the remedial action objectives (RAOs) and potential ARARs for remedial actions that will be evaluated in the FS.

Note: Because of their size, Figures 9-1 through 9-7 are located at the end of the section.

10.1 Summary of RI Findings

Sufficient characterization has been conducted at each of the AOCs to evaluate potential risks posed by MEC and MC and to determine the need for further action to address unacceptable risk. Tables 10-1 through 10-24 provide summaries of the RI site characterization findings for each AOC; investigation history and results, applicability to Level 2 Methodology, nature and extent conclusions, current ESHA score, MC risk findings, uncertainties, and overall conclusions and recommendations for each AOC at OU B-2, including RG-01, are presented.

TABLE 10-1

Summary of RI Findings and Conclusions—ALDA-01

AOC Type:	Disposal Area
Investigation History:	**1999:** Surface sweep to remove metallic debris and MEC followed by ribbon walk. Several of MEC items were found at the surface and, based on the presence of several large surface craters, were suspected to have come from possible use of the area for demolition. The ribbon walk was modified to a 100 percent grid because of the large number of anomalies discovered. More than 900 targets were identified, with individual targets difficult to discern in many areas. Six representative target areas were chosen for investigation using a trackhoe. Trenches and test pits were dug to a depth of 4 feet to investigate the dense anomalies. At the longest investigation trench, 500 pounds of scrap metal were removed. In addition, 33 individual targets were also investigated in southern parts of the AOC where it was possible to isolate targets. Items found buried in the area consisted of mostly metal debris; however, DMM was also found. **2008:** Instrument-aided evaluation of four craters and collection of one three-point composite soil sample and field duplicate for MC analyses within one crater. Four possible detonation craters located in the center of the AOC were investigated and only non-munitions-related metal debris and frag were found. Northern portion of ALDA-01 was included in Grid 12, intended to identify the possible location of a small arms burial area at ALSW-01, and in the instrument-aided visual inspection used to better determine the extent of metal debris possibly employed in construction of the seawall (also known as the western transect). Items found in ALDA-01 during the course of the intrusive investigation at Grid 12 and the western transect included metal waste, cables, angle irons, and other debris; no MEC was found.
Investigation Results:	Materials found in 1999 consisted primarily of DMM and MPPEH (60-mm mortar bodies, 40-mm MK II (unfuzed/unfired): M47A2 incendiary gasoline gel bomb case with possible burster tube and residue), and variety of metal debris. Only metal debris found in 2008 crater anomaly investigation. No MC detected in soil sample collected at one of the blast craters, and no other potential sources of MC (i.e., breached munitions) found.
Applicability of Work to Level 2 Methodology:	Investigations conducted to date at ALDA-01 only partially fulfill Level 2 Methodology requirements for a disposal area because a 100 percent intrusive investigation of all identified anomalies has not been conducted. Sufficient information has been gathered to make a determination about potential hazards and to evaluate potential remedies to address the hazards in the FS.

TABLE 10-1
Summary of RI Findings and Conclusions—ALDA-01

Nature and Extent Conclusions:	Site use consistent with AOC type. DMM and MPPEH intermingled with debris and rocks on surface and in subsurface. Geophysical anomalies indicated buried debris over 4.7 acres. Field observations from limited intrusive investigation indicate debris extends at least 4 feet bgs. Based on the topography of the uninvestigated areas to the west and south and the proximity of Andrew Lake to the east, it is unlikely that the disposal area extends much beyond the limits of the survey area. Possible use of the area for demolition, if at all, appears to have been limited. MEC found at the surface in 1999 may be related to such use, or may have been washed into the area from an offshore area during storm events. No MC was detected in a soil sample collected at one of the blast craters, and no other potential sources of MC (i.e., breached munitions) were found. Based on these results, the surface soil at ALDA-01 does not appear to be impacted by releases of MC. Soil not contaminated with MC.
Current ESHA Score:	C
MC Risk:	No unacceptable risk posed by human or ecological exposure to MC.
Uncertainties:	Amount and distribution of MEC within the disposal area has not been determined. Northern extent of disposal area has not been defined and appears indistinguishable from metal debris i seawall and beach headwall. The degree to which MEC is present in this area is unknown.
Conclusions:	MEC is intermingled with other materials placed in disposal area and may pose potential hazard to future users.
Recommendations:	Further evaluation to address MEC contamination (forward to FS). No further evaluation required to address MC contamination.

TABLE 10-2
Summary of RI Findings and Conclusions—ALDA-02

AOC Type:	Aerial Bombing Range/Possible Disposal Area
Investigation History:	**2000:** Site walks by Project Team members and UXO professionals. Conditions noted during the site walks included rugged terrain, exposed bedrock, and steep slopes. **2008:** Collection of one sediment sample from within the bed of the stream that originates in C1-01 and flows to the north through ALDA-02 into Andrew Bay. The western transect at ALSW-01 extended into ALDA-02.
Investigation Results:	No MEC items found at surface during 2000 site walks. Terrain is steep and bedrock is shallow in this area, making it difficult to walk or dig. No geophysical surveys or intrusive investigations were performed. Site was characterized as NOFA for MEC because bedrock is shallow, which would promote high order detonation of any bombs dropped. Concentrations of all target analytes were below detection limits in the sediment sample collected in 2008.
Applicability of Work to Level 2 Methodology:	Site walk/visual observation does not meet Level 2 Methodology requirements for aerial bombing range. However, site conditions are not suitable for completions of geophysical survey and intrusive investigation. Additional site reconnaissance to evaluate possible MEC disposal will be performed in 2012.
Nature and Extent Conclusions:	Site use may not be consistent with AOC type based on location and examination of aerial photographs. Additional site reconnaissance to evaluate possible MEC disposal will be performed in 2012. Site was characterized as NOFA for MEC prior to 2008 investigation because investigation would be very difficult and bedrock is shallow, which would promote high order detonation of any bombs dropped. The western transect at ALSW-01 extended into ALDA-02 and no surface or subsurface MEC was found Sediment not contaminated with MC.
Current ESHA Score:	A
MC Risk:	No unacceptable risk posed by human or ecological exposure to MC.
Uncertainties:	No geophysical surveys or intrusive investigations were performed. Recent aerial photograph analysis indicates possible historical MEC disposal in vicinity of AOC.
Conclusions:	Site was characterized as NOFA for MEC prior to 2008 investigation. Depending on results of 2012 site reconnaissance, the AOC may be reassigned to the FS Area category.
Recommendations:	Currently, Adak no further action with baseline institutional controls. The AOC may be reassigned to the FS category following 2012 field reconnaissance.

TABLE 10-3
Summary of RI Findings and Conclusions—ALSW-01

AOC Type:	Wash-Up Area for MEC
Investigation History:	ALSW-01 Terrestrial Area: The 2008 RI focused on possible subsurface MEC along upland portions of the seawall and the upland portion of the AOC west of the spillway. The study included a geophysical survey and limited intrusive investigation along transects that followed the top and sides of the seawall east of the spillway; a detector-aided visual inspection west of the spillway; and a 100 percent geophysical survey and limited intrusive investigation of a 30-m by 30-m grid at the expected location for a small arms burial area west of the spillway. The intrusive investigations were limited by the extremely rough and cobbly nature of the seawall, as well as the high density of anomalies caused by the apparent use of metal debris in seawall construction. No MEC was found in the areas addressed by the 2008 RI. ALSW-01 Intertidal and Marine Areas: Navy EOD personnel periodically perform visual and detector-aided inspections and removal of MEC (seawall sweeps). Sweeps have been conducted annually since 2004. Information on the seabed composition is limited. A Navy EOD report noted that the rocky conditions along the shoreline persist well offshore. Included in the work effort offshore of the ALSW was a surface and underwater visual survey. Navy personnel performed surface swims and identified munitions on the sea bottom in the vicinity of the Lake Andrew Spillway along a 550-yard traverse at a water depth of approximately 15 feet. The munitions observed included 40-mm projectiles to 81-mm mortars and an unconfirmed occurrence of a depth charge. The swimmers reported that many munitions may have been present, but could have been obscured by boulders. The composition of the bottom through the tidelands and into submerged lands was reported as a solid layer of boulders out to a water depth of approximately 50 feet. Mixed sand and rock were noted at depths of 50 to 100 feet. The presence of kelp was observed as minimal by Navy personnel in August 2000.
Investigation Results:	Items found at surface during annual surface sweeps consist of DMM, MD, and metal debris.
Applicability of Work to Level 2 Methodology:	There is no Level 2 Methodology for wash-up area. However, sufficient MEC data are available to define the remedial action area for the FS evaluation.
Nature and Extent Conclusions:	Site use consistent with the AOC type Variety of MEC and MPPEH on the surface of the shoreline and nearby uplands. Most items found were highly deteriorated, likely the result of abrasion in heavy wave action, surf, and surge activity in a rugged marine environment. Approximately 10 to 20 items are recovered from the seawall each year. Data on quantities, munitions type, category, condition, and specific location varied considerably. Quantifiable and reliable trending analysis for these data is not possible. MEC may also be present in the subsurface as a result of burial by more recent accumulations of cobbles and boulders. However, these surface conditions preclude intrusive investigation. The current lateral deposition limits for MEC along the Andrew Lake Seawall are at approximately 300 yards west and 800 yards east of the Andrew Lake spillway. These limits were verified during site visits in 2010. The location or areal extent of the offshore MEC source have not been determined
Current ESHA Score:	D
MC Risk:	Not applicable.
Uncertainties:	The location and areal extent, of the offshore MEC source have not been determined.
Conclusions:	MEC found and poses potential hazard to future users.
Recommendations:	Further evaluation to address MEC contamination (forward to FS).

Table 10-4
Summary of RI Findings and Conclusions—BC-03

AOC Type:	Firing Point
Investigation History:	**1999:** 100 percent instrument-aided reconnaissance in accessible areas. All contacts intrusively investigated. Only metal debris found.
Investigation Results:	100 percent instrument-aided reconnaissance in accessible areas. All contacts intrusively investigated. Only metal debris found.
Applicability of Work to Level 2 Methodology:	All Level 2 Methodology requirements for firing point fulfilled.
Nature and Extent Conclusions:	No MEC found.
Current ESHA Score:	A
MC Risk:	Not applicable.
Uncertainties:	None.
Conclusions:	No MEC found. AOC assigned NOFA status prior to the 2008 investigation.
Recommendations:	Adak no further action with baseline institutional controls

Table 10-5
Summary of RI Findings and Conclusions—C1-01

AOC Type:	Target/Impact Area
Investigation History:	**1999:** Ribbon walk covering a 1-meter-wide random pathway approximately 8.8 miles long. **2000:** 45.4 miles of transect using a 105 m spacing intended to fill data gaps and to create an overall investigation pattern approximating the design transect spacing for a mortar impact area. **2008:** Accessibility assessment for boundary definition along eastern side of AOC. Site reconnaissance for erosion and site stability. Soil sampling for MC at two breached munitions locations. Sediment sample from stream that drains area (sample physically located in ALDA-02).
Investigation Results:	During the 1999 and 2000 surveys, 648 targets (100%) were intrusively investigated. Items found consist of UXO (60-mm and 81-mm mortars; 20-mm, 37-mm, and 40-mm projectiles) and MD. Items typically encountered within 2 feet of surface. All encountered MEC items recovered and destroyed. Slopes along eastern boundary found to be greater than 30 degrees, not accessible for further MEC survey to define eastern limits of target/impact area. No MC detected in soil sample collected at possible breached munitions location or in sediment sample collected downstream of AOC (sample physically located in ALDA-02).
Applicability of Work to Level 2 Methodology:	Level 2 Methodology requirements for target/impact area fulfilled.100 percent geophysical mapping and intrusive investigation using maximum transect spacing based on 60-mm mortars. Transect spacing did not account for impact of 20-mm projectiles, which were found in area.
Nature and Extent Conclusions:	Site use consistent with AOC type. Items found consisted of UXO (60-mm and 81-mm mortars; 20-mm, 37-mm, and 40-mm projectiles) and MPPEH. Items typically encountered within 2 feet of surface. Approximate extent of target/impact area determined by geophysical survey and intrusive investigation. MD found in vicinity of slumped soil along eastern boundary. Complete delineation of eastern boundary not feasible due to presence of steep terrain. Soil not contaminated with MC.
Current ESHA Score:	D
MC Risk:	No unacceptable risk posed by human or ecological exposure to MC.
Uncertainties:	Transect spacing did not account for 20-mm projectiles. MEC with smaller fragmentation distances may have been missed by this survey. Degree to which MEC may be present on steep slopes adjacent to investigated portions of AOC has not been determined. Eastern extent of target/impact area has not been delineated.
Conclusions:	MEC found, remaining MEC poses potential hazard to future users.
Recommendations:	Further evaluation to address MEC contamination (forward to FS). No further evaluation required to address MC contamination.

Table 10-6
Summary of RI Findings and Conclusions—HG-01

AOC Type:	Target/Impact Area
Investigation History:	**1999:** Ribbon walk to obtain one-dimensional geophysical data along a random, representative route through the site. The spacing used for the ribbon walk was very narrow, covering a 1-meter-wide route 4.85 miles in length and providing nearly 100 percent geophysical coverage of the AOC. One hundred and eighty (180) targets were identified in this area, of which 155 were selected for intrusive investigation. **2008:** Intrusive investigation of 25 uninvestigated target anomalies identified during previous investigation. Geophysical and intrusive investigation of two 30 m by 30 m grids (Grids 8 and 9) centered on the locations of two prior MEC discoveries. No evidence of breached items that might be sources of MC found; no samples collected.
Investigation Results:	Site use consistent with the AOC type. During the 1999 investigation two M441 40-mm grenades, 60-mm mortars (unfuzed) and related waste, several CADs, a dummy 3.5-inch rocket, and numerous pieces of unidentified fragments were found within 2 feet of the surface. During the 2008 investigation, the previously uninvestigated targets were found to be metal debris, MD, and one no-find. Two additional MEC items (40-mm projectiles, HE M406) found in previously cleared portion of Grid 9. One UXO item was located on the eastern boundary of Grid 9. However, no expansion grids or step-out transects were conducted because no MEC items were found along the adjacent RR-01 transects. No MEC found in Grid 8. All encountered MEC items recovered and destroyed.
Applicability of Work to Level 2 Methodology:	Level 2 Methodology requirements for target/impact area fulfilled.
Nature and Extent Conclusions:	100 percent survey and investigation of anomalies in accessible areas (approximately 20 percent of AOC not investigated). Items found at the surface and subsurface consisted of UXO, MD, .30 and .50 caliber projectiles, and a variety of metal wastes. All MEC items were found within 2 feet of the surface.
Current ESHA Score:	D
MC Risk:	Not applicable.
Uncertainties:	Possible quality issues associated with 1999 investigation because of finds of UXO in previously cleared portion of AOC.
Conclusions:	Characterization complete, 80 percent survey and investigation, all selected targets cleared. However, UXO found during 2008 in previously cleared area and the 20 percent coverage gap suggests that additional MEC may be present in area surveyed in 1999.
Recommendations:	Further evaluation to address MEC contamination (forward to FS).

Table 10-7
Summary of RI Findings and Conclusions—JM-01

AOC Type:	Disposal Area
Investigation History:	**2000:** Extensive search was conducted to locate JM-01 based on an interview with a WWII veteran. The Navy brought the veteran to Adak in an effort to locate the site of the alleged disposal. J.M. identified areas east of Lake Jean that he believed were the sites of a storage bunker and the alleged disposal site. Field staff searched the potential disposal area with a Vallon metal detector and noted positive hits for fallen fence posts and remnants of a coal-burning camp stove. **2001:** Navy sought other candidate sites for recon using 2001 low-altitude aerial photos, archive aerial photos, and archive maps. Thirteen candidate sites were selected for possible site recon. Analysis did not confirm any of the candidate sites and did not suggest any other likely locations for this disposal activity.
Investigation Results:	AOC has not been located, characterization not feasible.
Applicability of Work to Level 2 Methodology:	Not applicable, site not located.
Nature and Extent Conclusions:	AOC has not been located.
Current ESHA Score:	A
MC Risk:	Not applicable.
Uncertainties:	None.
Conclusions:	AOC has not been located, characterization not feasible. AOC was assigned NOFA status prior to the 2008 investigation.
Recommendations:	Adak no further action with baseline institutional controls

Table 10-8
Summary of RI Findings and Conclusions—LJ-02A

AOC Type:	Disposal Area
Investigation History:	**1999:** Ribbon walk geophysical survey covering one transect through the site when it was part of LJ-02. **2002:** Follow-on EM-31 geophysical survey when LJ-02A was created as a result of field observation (potential trench locations) made during the search for JM-01. While no anomalies indicative of trenches were visible in the data, three point source anomalies were identified. All three of these targets were intrusively investigated and were found to be metal debris at depths between 0 and 1 foot below ground surface.
Investigation Results:	100 percent survey and investigation, only metal debris found.
Applicability of Work to Level 2 Methodology:	Level 2 Methodology requirements for disposal area fulfilled.
Nature and Extent Conclusions:	Site use not consistent with AOC type, no evidence of MEC disposal found. 100 percent survey and investigation, no MEC found.
Current ESHA Score:	A
MC Risk:	Not applicable.
Uncertainties:	None.
Conclusions:	Characterization complete, 100 percent survey and investigation, no MEC found. AOC was assigned NOFA status prior to the 2008 investigation.
Recommendations:	Adak no further action with baseline institutional controls

Table 10-9
Summary of RI Findings and Conclusions—MAG-01

AOC Type:	Storage Magazine
Investigation History:	No investigations prior to 2008. During 2001, the former gun emplacement just north of this AOC was evaluated using a detector-aided visual inspection. Packing materials, including M-50/M-54 end caps and pieces of burned Thermite residue, were found. It is not known whether this material was related to the former magazine. **2008:** Instrument-aided visual inspection and site reconnaissance of the accessible portions of the AOC. The planned MEC investigation in the southern portion of the AOC was modified by FCR 15 to observation of accessible portions of AOC by cutting 4-foot-wide paths approximately 8 to 10 feet apart through heavy vegetation and conducting a detector-aided and visual inspection of the area. No evidence of breached items that might be sources of MC found; no soil samples collected.
Investigation Results:	Accessible areas (i.e., slopes of less than 30 degrees and areas not covered by water) in the northern portion of the AOC were fully swept as planned. Several large subsurface anomalies in the southern part of the AOC were determined to be cables and barrels. The majority of the debris was found adjacent to an overgrown road that runs north to south through the center of MAG-01. No MEC found.
Applicability of Work to Level 2 Methodology:	Partial survey and intrusive investigation partially satisfies Level 2 Methodology requirements for storage magazine. However, no evidence of storage magazine or MEC was found and sufficient information has been gathered to make a determination about potential hazards and to evaluate potential remedies to address the hazards in the FS.
Nature and Extent Conclusions:	Site use not consistent with AOC type, no evidence of possible storage magazine found. No evidence of possible storage magazine found and only non-munitions-related metal debris found at surface and subsurface.
Current ESHA Score:	A
MC Risk:	Not applicable.
Uncertainties:	Limited portion of accessible area in southern portion of the AOC not surveyed.
Conclusions:	No evidence of possible storage magazine found and no MEC found; potential for MEC in uninvestigated portions of AOC is low.
Recommendations:	Adak no further action with baseline institutional controls

Table 10-10
Summary of RI Findings and Conclusions—MI-01

AOC Type:	Target/impact area
Investigation History:	**1999:** Ribbon walk covering a 1-meter-wide random pathway approximately 0.1 mile long followed by intrusive investigation at six of 15 targets. **2008**: Geophysical survey and intrusive investigation at two 30 m by 30 m grids (Grids 5 and 6) centered on prior MEC finds. Step-out transects (X1 through X4) required east of Grid 6 at MI-01 to define AOC boundary. Expansion grids/step-out transects for MEC finds along other Grid 5 and 6 boundaries deferred to remedial action based on similarity in MEC distribution in nearby MI-02 and MI-03. Soil sampling for MC at previously identified possible breached munitions location.
Investigation Results:	Items found in 1999 included a single fired grenade, 3.5-inch practice rocket with live motor, a 2.36-inch practice rocket, and metal debris. All items found within 1 foot of surface. Items found in 2008 consist primarily of UXO (2.36-inch and 3.5-inch rockets, 40-mm projectiles, and rifle grenades) and MPPEH (rocket motors). UXO items found within 1 foot of surface. UXO (rockets and rifle grenades) found in step-out transects X2 and X3, indicating possible overlap with MI-03. All encountered MEC items recovered and destroyed. No MC detected soil sample collected at former rocket location, and no other potential sources of MC found.
Applicability of Work to Level 2 Methodology:	100 percent survey and intrusive investigation of grids centered on previous MEC finds partially completes Level 2 Methodology requirements for disposal area. Sufficient information has been gathered to make a determination about potential hazards and to evaluate potential remedies to address the hazards in the FS.
Nature and Extent Conclusions:	Site use consistent with the AOC type. Items found consist primarily of UXO (2.36-inch and 3.5-inch rockets, 40-mm projectiles, and rifle grenades) and MPPEH (rocket motors). UXO (rockets and rifle grenades) found in step-out transects X2 and X3, indicating possible overlap with MI-03. All items found within 1 foot of surface. Abundance and type of MEC in uninvestigated portions of AOC assumed to be similar to that found in Grids 5 and 6. Approximate extent determined by geophysical survey and intrusive investigation, but appears to overlap with MI-03 target/impact area. Soil not contaminated with MC.
Current ESHA Score:	D
MC Risk:	No unacceptable risk posed by human or ecological exposure to MC.
Uncertainties:	Possible MEC between and south of grids not investigated.
Conclusions:	MEC found, remaining MEC poses potential hazard to future users.
Recommendations:	Further evaluation to address MEC contamination (forward to FS). No further evaluation required to address MC contamination.

Table 10-11
Summary of RI Findings and Conclusions—MI-02

AOC Type:	Target/Impact Area
Investigation History:	**1999:** Ribbon walk covering a 1-meter-wide random pathway approximately 4.5 miles long followed by intrusive investigation at 78 of 104 targets. **2008:** Geophysical survey and intrusive investigations along 12 transects and in four 30 m by 30 m grids, two of which (Grids 1 and 2) were centered on prior MEC finds, and two (Grids 3 and 4) that were located on the apparent northern and eastern boundaries of the AOC with MI-03 to assist in boundary delineation. Step-out transects (16A, 16A, 17A) required on north side of Grid 3. Expansion grids for other MEC finds within AOC deferred based on similarity in MEC distribution in nearby MI-01 and MI-03. Soil sampling for MC at previously identified possible breached munitions location and groundwater sampling for MC from two seeps along valley wall. Erosion/instability reconnaissance.
Investigation Results:	Materials found in 1999 and 2008 consist of UXO (2.36-inch and 3.5-inch rockets, 40-mm projectiles, and mortars), MPPEH, and metal fragments. All items found within 2 feet of surface. All encountered MEC items recovered and destroyed. Features indicative of erosion were identified, but do not appear to be factor in potential MEC migration. No MC detected in soil sample collected at possible breached munition location or in groundwater samples collected from seeps and no other potential sources of MC found.
Applicability of Work to Level 2 Methodology:	Level 2 Methodology requirements for target/impact area fulfilled.
Nature and Extent Conclusions:	Site use consistent with the AOC type. Materials found consist of multiple 40-mm projectiles and 2.36-inch rockets, 60-mm mortar body, 75-mm projectile, and MPPEH from 60- and 81-mm mortars. MEC concentrated along a northeast-southwest-trending zone through center of AOC. One item found in extreme northwest corner (Grid 1) of AOC. All MEC found within 2 feet of surface Abundance and type of MEC in areas outside 30 meter by 30 meter grids assumed to be similar to that found in Grids 1 through 4. Approximate extent of target/impact area determined by DGM survey and intrusive investigation and encompasses the portion of MI-02 where UXO and MD were found. Boundaries with MI-01 and MI-03 are indistinct and steep slopes along the northern and southern margins of the AOC limit possible refinement of the target/impact area. Soil not contaminated with MC.
Current ESHA Score:	D
MC Risk:	No unacceptable risk posed by human or ecological exposure to MC.
Uncertainties:	Degree to which MEC may be present on steep slopes adjacent to investigated portions of AOC has not been determined.
Conclusions:	MEC found, remaining MEC poses potential hazard to future users.
Recommendations:	Further evaluation to address MEC contamination (forward to FS). No further evaluation required to address MC contamination.

Table 10-12
Summary of RI Findings and Conclusions—MI-03

AOC Type:	Target/Impact Area
Investigation History:	**1992:** Surface water and sediment samples collected from Moffett Creek. **1999:** Ribbon walks covering a 1-meter-wide random pathway approximately 16.7 miles long followed by intrusive investigation at 220 of 402 targets. **2008**: Geophysical survey and intrusive investigations along numerous transects and in two grids (Grids 7 and 8). Soil sampling for MC at previously identified possible breached munitions location. Erosion/instability reconnaissance.
Investigation Results:	Materials found in 1999 and 2008 consist of UXO (grenades, mortars, and 40-mm projectiles), MD, and metal fragments. All items found within 2 feet of surface. All encountered MEC items recovered and destroyed. Features indicative of erosion were identified, but do not appear to be factor in potential MEC migration. No COPCs identified for surface water or sediment in 1996 screening level risk assessment. No MC detected in 2008 soil sample collected at possible breached munition location and no other potential sources of MC found.
Applicability of Work to Level 2 Methodology:	Level 2 Methodology requirements for target/impact area fulfilled.
Nature and Extent Conclusions:	Site use consistent with the AOC type. Materials found consist of 60- and 81-mm mortars, 40-mm projectiles, 2.36-inch and 3.5-inch rockets, and rifle grenades. MEC found primarily in eastern portion of AOC, but isolated items found in western part of AOC adjacent to northern and southern valley walls. MD, but no MEC or MPPEH, found on ridge on north side of AOC. All MEC found within 2 feet of surface Abundance and type of MEC in areas outside 30 meter by 30 meter grids assumed to be similar to that found in Grids 7 and 8. Approximate extent of the target/impact area was determined by DGM survey and intrusive investigation and encompasses the portion of MI-03 where UXO and MD were found. All items found within 2 feet of surface. Surface water, sediment, and soil not contaminated with MC.
Current ESHA Score:	D
MC Risk:	No unacceptable risk posed by human or ecological exposure to MC.
Uncertainties:	Degree to which MEC may be present on steep slopes adjacent to investigated portions of AOC has not been determined.
Conclusions:	MEC found, remaining MEC poses potential hazard to future users.
Recommendations:	Further evaluation to address MEC contamination (forward to FS). No further evaluation required to address MC contamination.

Table 10-13
Summary of RI Findings and Conclusions—MM-10D

AOC Type:	Target/Impact Area
Investigation History:	**1999:** Geophysical survey of 0.037 mile of ribbon walk to obtain one-dimensional geophysical data along a loop through the area. **2000:** Follow-up with an additional 0.24 mile of geophysical mapping to perform the then-approved expansion-pattern investigation of the MD item found in 1999.
Investigation Results:	Single fragment of 81-mm mortar found and removed in 1999. No additional items found during 2000 survey.
Applicability of Work to Level 2 Methodology:	Level 2 Methodology requirements for target/impact area fulfilled.
Nature and Extent Conclusions:	Site use not consistent with AOC type, no MEC found. 100 percent survey and investigation, no MEC found.
Current ESHA Score:	A
MC Risk:	Not applicable.
Uncertainties:	None.
Conclusions:	Characterization complete, 100 percent survey and investigation, no MEC found. AOC was assigned NOFA status prior to the 2008 investigation.
Recommendations:	Adak no further action with baseline institutional controls

Table 10-14
Summary of RI Findings and Conclusions—OB/OD-01

AOC Type:	OB/OD Disposal Area
Investigation History:	**1992:** Soil sampling (10 samples) for multiple target analytical suites from historical operating and emergency burn pan locations. **1996:** Characterization of soil following removal of burn pan and associated soil. **1999:** 100 percent geophysical survey (grid) of the AOC. Limited targets (38%) in selected grids were intrusively investigated to provide representative data regarding the types and potential quantities of MEC items present. **2008**: Soil sampling for MC at previously identified possible breached munitions locations. Grain size analysis of one sample.
Investigation Results:	Items found in 1999 consisted of one M34 WP grenade, one M26 HE grenade, fuzes, initiators, CADs, and a variety of metal wastes All encountered MEC items recovered and destroyed. MC, SVOCs, and VOCs detected in 1992 soil samples. A 1997 detailed risk assessment indicated that for human health, site soils posed no significant risk to hypothetical residential, recreational, or occupational use, and for ecological health, a small area beneath the burn pan was found to pose risk. The burn pan, its contents, and the underlying soil were removed. Nitroglycerin detected in one of the three 2008 soil samples, but detected concentration was lower than the project screening level. MC not detected in the other two soil samples.
Applicability of Work to Level 2 Methodology:	100 percent geophysical mapping of 30 m by 30 m grids covering the site, but 38 percent investigation of anomalies only partially satisfies Level 2 requirements for OB/OD area.
Nature and Extent Conclusions:	Site use consistent with AOC type. Items found consisted of one M34 WP grenade, one M26 HE grenade, fuzes, initiators, CADs, and a variety of metal wastes All items found within 2 feet of surface (4 feet maximum investigation depth). Numerous anomalies not investigated. Abundance and type of MEC in uninvestigated portions of AOC assumed to be similar to that found in grids selected for intrusive investigation. Approximate extent of the OB/OD-01 defined by the outer-most extent of anomalies identified by the geophysical survey, which in many cases extend beyond the designated boundary of OB/OD-01. SVOCs and VOCs detected in 1992 soil samples. A 1997 detailed RA indicated that site soils posed no significant risk to hypothetical residential, recreational, or occupational use for human health. For ecological health, a small area beneath the burn pan was problematic. The burn pan and its contents were removed and the soil results are not considered representative of current conditions. Nitroglycerin detected in one of the three 2008 soil samples, but detected concentration was lower than the project screening level. MC not detected in the other two soil samples.
Current ESHA Score:	D
MC Risk:	No unacceptable risk posed by human or ecological exposure to MC.
Uncertainties:	Intrusive investigation of remaining anomalies; anomalies appear to extend beyond the designated boundary of OB/OD-01, and in some cases into AOCs already slated for further evaluation.
Conclusions:	MEC found, remaining MEC poses potential hazard to future users.
Recommendations:	Further evaluation to address MEC contamination (forward to FS). No further evaluation required to address MC contamination.

Table 10-15
Summary of RI Findings and Conclusions—RG-01

AOC Type:	Target/Impact Area
Investigation History:	No formal investigations conducted prior to 2006 as a result of the catastrophic hazard rating for 40-mm grenades. **2006:** Engineering Evaluation/Cost Analysis and Action Memorandum completed, recommending 100 percent surface and subsurface removal of MEC and munitions debris to a depth of 2 feet from the entire 16 acres of the RG-01 project site. NTCRA began in 2006 field season with analog clearance of 19,002 surface and subsurface anomalies. **2008:** Analog clearance on the five expansion areas identified during 2006, plus clearance of additional expansion areas because of finds of 40-mm grenades in another grid. A 100 percent DGM survey of accessible areas was performed after completion of the analog clearances. During the DGM clearance, MEC was encountered near boundaries of four of the five grids and it was necessary to perform a step-out of the grids to maintain the 15 m buffer around MEC. All additional step-outs were first analog cleared and then DGM surveyed and cleared. Collection of soil samples at two locations where breached munitions were found during 2008 NTCRA. Follow-up sampling required at one location where RDX was detected above project screening levels.
Investigation Results:	Items found in 2006 and 2008 consisted of variety of UXO and MPPEH, including M433 40-mm HEDP grenades, M651 40-mm riot tear gas, M397 40-mm HE grenades, M716 40-mm smoke grenades, 60-mm mortar, 81-mm mortar, CAD, and M28 3.5-inch HEAT rocket. All MEC items were recovered and destroyed. MPPEH items included a projectile fuze, a bomb fuze, a 40-mm projectile, a CAD, and two 40-mm breached munitions. MPPEH items were vented or demilitarized by detonation. Based on observations by UXO personnel, the MPPEH items, rocket, and breached munitions were most likely “kick-outs” from the nearby former OB/OD area. The area was also extensively used for firing of small arms up to and including .50 caliber weapons. Operations on site were not able to locate or identify a traditional firing point for the 40-mm grenade launchers. RDX and HMX detected in initial soil sample collected at one breached munitions location, with RDX concentration above project screening level. RDX also detected in several follow-up samples at location, but at concentrations below the project screening level.
Applicability of Work to Level 2 Methodology:	All Level 2 Methodology requirements for target/impact area fulfilled.
Nature and Extent Conclusions:	Characterization and clearance of all detected MEC in accordance with the project plans, completed during NTCRA. All recovered MEC was destroyed. RDX and HMX detected in initial soil sample collected at one breached munition location, with RDX concentration above project screening level. RDX also detected in several follow-up samples at location, but at concentrations below the project screening level.
Current ESHA Score:	A
MC Risk:	No unacceptable risk posed by human or ecological exposure to MC.
Uncertainties:	None.
Conclusions:	Characterization and remediation of AOC completed during NTCRA.
Recommendations:	Adak no further action with baseline institutional controls

Table 10-16
Summary of RI Findings and Conclusions—RR-01

AOC Type:	Target/Impact Area
Investigation History:	**1992:** Sediment and surface water samples collected from Moffett Creek. **1995:** Sediment samples collected from Moffett Creek. **1999:** Geophysical survey of approximately 17.4 miles of transect (ribbon walk); intrusive investigation of 420 targets (67% of those identified) in north central portion of AOC where a known-distance rifle range was located. **2008:** Geophysical survey at numerous transects and intrusive investigations. No expansion grids or step-out transects required at AOC boundaries. Instrument-aided visual inspection in previously uninspected areas in southern portion of AOC. Site reconnaissance for erosion features. Sediment sampling for MC at Moffett Creek. No evidence of breached items that might be sources of MC found; no soil samples collected.
Investigation Results:	Items found at RR-01 in 1999 and 2008 consist of UXO (2.35-inch rockets, 40-mm projectiles, 37-mm projectile, a 5-inch rocket), MPPEH, and metal fragments. Most UXO was found within 1 foot of the surface. Small pieces of heavy cased munitions found in previously uninspected southern portion of AOC. Features indicative of erosion were identified, but do not appear to be factor in potential MEC migration. No COPCs were identified for surface water or sediment in 1996 screening level risk assessment. No MC detected in 2008 sediment sample.
Applicability of Work to Level 2 Methodology:	Level 2 Methodology requirements for target/impact area partially fulfilled. Sufficient information has been gathered to make a determination about potential hazards and to evaluate potential remedies to address the hazards in the FS.
Nature and Extent Conclusions:	Site use consistent with the AOC type. Items found at RR-01 in 1999 and 2008 include 40-mm HE projectiles; 2.36-inch rockets, 40-mm grenades, 37-mm projectile, 5-inch rocket and MPPEH. MEC primarily found in south-central, and southwestern portions of AOC near southern valley wall. Most UXO was found within 1 foot of the surface. All anomalies in former known-distance rifle range AOC not investigated. Based on items found, MEC may remain in this area. Abundance and type of MEC assumed to be similar to that found along other transects in area. Approximate extent of the target/impact area has been bounded and surface conditions in previously uninspected portions of the AOC south of the target/impact area are not indicative of possible impact. Surface water and sediment not contaminated with MC.
Current ESHA Score:	D
MC Risk:	No unacceptable risk posed by human or ecological exposure to MC.
Uncertainties:	All anomalies in former known-distance rifle range AOC not investigated. Degree to which MEC may be present on steep slopes adjacent to investigated portions of AOC has not been determined.
Conclusions:	MEC found, remaining MEC poses potential hazard to future users.
Recommendations:	Further evaluation to address MEC contamination (forward to FS). No further evaluation required to address MC contamination.

Table 10-17
Summary of RI Findings and Conclusions—RR-02

AOC Type:	Range Buffer Zone
Investigation History:	**1999:** Geophysical survey of approximately 7.5 miles of transect (ribbon walk); intrusive investigation of 44 targets (100% of those identified). **2008:** Geophysical survey and intrusive investigation of a series of transects spaced at 25 m in the uncharacterized accessible areas in the north central portions of the AOC. Instrument-aided visual inspection and site reconnaissance of the accessible, northeastern, southwestern, and western portions of the AOC. Collection of a MIS soil sample for MC and perchlorate analyses at one previously identified breached munitions anomaly location near the northern tip of RG-01 where a cluster of items was found during prior investigations.
Investigation Results:	AOC investigated as possible target/impact area based on 1999 MD finds. Items found in 1999 and 2008 consist mostly of a variety of MD and metal waste, most likely carried over from adjacent ranges. No UXO items were found. Surface conditions in previously uninspected portions of the AOC not consistent with those of an impact area. No MC was detected in the soil sample and no additional breached items were identified during the 2008 field investigation.
Applicability of Work to Level 2 Methodology:	All Level 2 Methodology requirements for target/impact range fulfilled.
Nature and Extent Conclusions:	Site use consistent with initial AOC type (range buffer zone) rather than adjusted AOC type (target/impact area). AOC investigation completed in accordance with RI Work Plan. No MEC found. Items found consisted of a variety of MD and metal waste, most likely carried over from adjacent ranges. No UXO items were found. Surface conditions in previously uninspected portions of the AOC not consistent with those of an impact area. Soil not contaminated with MC.
Current ESHA Score:	A
MC Risk:	No unacceptable risk posed by human or ecological exposure to MC.
Uncertainties:	None.
Conclusions:	Characterization complete, AOC surveyed and intrusively investigated, no MEC found.
Recommendations:	Adak no further action with baseline institutional controls

Table 10-18
Summary of RI Findings and Conclusions—RR-03

AOC Type:	Range Buffer Zone
Investigation History:	**1999:** Ribbon walk covering a 1-meter-wide random pathway approximately .006 mile long (one pass across the 30-meter-square site). A single abandoned signal flare was found. **2000:** An additional 1.01 miles of transect were walked to obtain 100 percent geophysical coverage of the site, followed by intrusive investigation of 39 targets (100 percent of those identified).
Investigation Results:	AOC investigated as possible target/impact area based on 1999 MD find. Most anomalies determined to be non-ordnance-related metal debris; only a possible 2.36-inch rocket with no fuze and the signal flare were found.
Applicability of Work to Level 2 Methodology:	All Level 2 Methodology requirements for target/impact area fulfilled.
Nature and Extent Conclusions:	AOC fully surveyed and intrusively investigated, all detected MEC items removed and disposed. AOC was assigned NOFA status prior to the 2008 investigation.
Current ESHA Score:	A
MC Risk:	Not applicable.
Uncertainties:	None.
Conclusions:	Characterization is complete, AOC fully surveyed and intrusively investigated, all MEC items removed and disposed. AOC was assigned NOFA status prior to the 2008 investigation.
Recommendations:	Adak no further action with baseline institutional controls

Table 10-19
Summary of RI Findings and Conclusions—RR-04

AOC Type:	Range Buffer Zone
Investigation History:	**1992:** Sediment and surface water samples collected from the mouth of Moffett Creek at the outflow to Andrew Lake just east of the boundary of AOC RR-04. **1999:** Field reconnaissance during the PSE and geophysical survey of approximately 12 miles of transect (ribbon walk); intrusive investigation of 87 targets (82 percent of those identified). **2008:** Geophysical and intrusive investigation of two transects in areas where previous data did not meet the Level 2 spacing required by the combat range model adopted for this AOC since none exists for this buffer area. Instrument-aided visual inspection and site reconnaissance of the accessible areas of the southwest corner of the AOC. Collection of one sediment sample for MC and perchlorate analyses within the Moffett Creek drainage channel about midway through the AOC. Collection of one co-located sediment and surface water sample for MC and perchlorate analyses within the Mitchell Creek drainage channel at the mouth of Moffett Creek, west of the road paralleling Andrew Lake. Collection of six shallow groundwater samples (three north and three south of Moffett Creek) near the Andrew Lake shoreline, west of the road paralleling Andrew Lake, for MC and perchlorate analyses. No evidence of breached items that might be sources of MC found; no soil samples collected.
Investigation Results:	Materials found at the surface and subsurface at RR-04 consisted of metals fragments and a variety of metal debris associated with use of the area as a support area for nearby ranges. No MEC was found; however, the 2008 investigation had an excessive number of no finds. Partially full container (55-gallon drum) of tar or similar petroleum product found along the transect in the eastern portions of the AOC in 2008. No COPCs identified for surface water or sediment in 1997 screening level risk assessment. No MC was detected in the 2008 sediment, surface water, or groundwater samples.
Applicability of Work to Level 2 Methodology:	No specific Level 2 Methodology for range buffer zone. Combat range methodology (mapping of transects spaced at 25 m) applied. All requirements fulfilled.
Nature and Extent Conclusions:	Site use consistent with the AOC type. AOC investigation completed in accordance with RI Work Plan. No MEC found. Materials found at the surface and subsurface consisted of metals fragments and a variety of metal debris associated with use of the area as a support area for nearby ranges. Partially full container (55 gallon drum) of tar or similar petroleum product found along the transect in the eastern portion of the AOC in 2008. Surface water, sediment, and groundwater not contaminated with MC.
Current ESHA Score:	A
MC Risk:	No unacceptable risk posed by human or ecological exposure to MC.
Uncertainties:	None.
Conclusions:	Characterization is complete, AOC surveyed and intrusively investigated, no MEC items found.
Recommendations:	Adak no further action with baseline institutional controls

Table 10-20
Summary of RI Findings and Conclusions—SA-01

AOC Type:	Small Arms Range
Investigation History:	**1999:** Field reconnaissance during the PSE and incidental encroachment. **2008:** 100 percent geophysical survey and intrusive investigation of one 30 m by 30 m grid centered on the area where the buried small arms munitions were previously discovered. Instrument-aided inspection and site reconnaissance of remaining accessible portions of the AOC. No evidence of breached items that might be sources of MC found; no soil samples collected.
Investigation Results:	Materials found at the surface and subsurface at SA-01 consist of small-caliber projectiles and metal wastes. No breached items identified; no soil sample collected.
Applicability of Work to Level 2 Methodology:	No specific Level 2 Methodology for small arms range. Disposal area methodology applied. All requirements fulfilled.
Nature and Extent Conclusions:	Site use consistent with the AOC type. AOC investigation completed in accordance with RI Work Plan. No MEC items found. Materials found at the surface and subsurface consist of small-caliber projectiles and metal wastes.
Current ESHA Score:	A
MC Risk:	Not applicable.
Uncertainties:	None.
Conclusions:	Characterization complete, AOC surveyed and intrusively investigated, no MEC items found.
Recommendations:	Adak no further action with baseline institutional controls

Table 10-21
Summary of RI Findings and Conclusions—SA93-01

AOC Type:	Target/Impact Area
Investigation History:	**1999:** Geophysical survey of approximately 12.5 miles of transect (ribbon walk) and intrusive investigation of 181 targets (100%). **2008:** Geophysical surveys and intrusive investigations, including numerous transects and one 30 m by 30 m grid (Grid 13). Step-out transects on east side of Grid 13 not surveyed because of steep ravine and similarity in finds in nearby SA93-03. Accessibility assessment for boundary definition along eastern and western sides of SA93-01. Site reconnaissance for erosion features. Soil sampling for MC at previously identified possible breached munitions locations. Surface water and sediment sampling in unnamed creek that drains SA93-01.
Investigation Results:	Materials found consist of multiple 2.36–in rockets, 37-mm projectiles, 57-mm projectiles, 75-mm projectiles, 60-mm mortars, 81-mm mortars, one 76-mm projectile, and associated MPPEH, as well as MD associated with impact. Most UXO items were encountered within 1 foot of the surface, although some items were found 2 to 4 feet below the surface during the 1999 and 2008 investigations. Extent of the target/impact area appears to extend eastward across the ravine and into SA93-03. Slopes along eastern and western boundaries found to be greater than 30 degrees, not accessible for further surveys to define the limits of the target/impact area. Features indicative of erosion were identified, but do not appear to be factor in potential MEC migration. No MC was detected in the soil, sediment, or surface water samples.
Applicability of Work to Level 2 Methodology:	Level 2 Methodology requirements for target/impact area fulfilled.
Nature and Extent Conclusions:	Site use consistent with the AOC type. Multiple mortars, projectiles, and rockets were found along a northwest/southeast alignment crossing through the AOC. Abundance and type of MEC in areas outside Grid 13 assumed to be similar to that found in Grid 13. The approximate extent of the target/impact area has been defined, although the eastern boundary with SA93-02 is indistinct due to steep terrain. Based on MEC results for the SA93-03 area, located just east of Grid 13, the impact area appears to extend from SA93-03, across an intervening ravine, and into SA93-01. Surface water, sediment, and soil at SA93-01 not contaminated with MC.
Current ESHA Score:	D
MC Risk:	No unacceptable risk posed by human or ecological exposure to MC.
Uncertainties:	Degree to which MEC may be present on steep slopes adjacent to investigated portions of AOC has not been determined.
Conclusions:	MEC found, remaining MEC poses potential hazard to future users.
Recommendations:	Further evaluation to address MEC contamination (forward to FS). No further evaluation required to address MC contamination.

Table 10-22
Summary of RI Findings and Conclusions—SA93-02

AOC Type:	Storage Area
Investigation History:	**1999:** Geophysical survey of approximately 4.1 miles of transect (ribbon walk); intrusive investigation of 70 targets (97% of those identified). **2008:** Instrument-aided visual inspection and site reconnaissance of the accessible portions of the AOC. Visual inspection of site features indicative of erosion and site instability that could be a factor for potential migration of MEC beyond AOC boundaries. Collection of co-located sediment and surface water samples for MC and perchlorate analyses within the Mitchell Creek drainage channel at the southern end of the AOC. No evidence of breached items that might be sources of MC found; no soil samples collected
Investigation Results:	The 1999 survey found only metal debris much of which was domestic in origin (auto parts, nuts and bolts). No MEC items found. The 2008 instrument-aided inspection and site reconnaissance found only an artillery lifting lug and an expended M48 series fuze and no evidence of impact or detonations. No MC was detected in the sediment and surface water samples collected downstream of the AOC.
Applicability of Work to Level 2 Methodology:	AOC investigated as possible storage area based on 1999 finds. All Level 2 Methodology requirements fulfilled.
Nature and Extent Conclusions:	Site use not consistent with either the initial (target/impact Area) or adjusted (storage area) AOC types. Inspection of the area suggests that most of the AOC was a range buffer zone. However, the uninvestigated ravine between SA93-01 and SA93-03 may be part of target/impact area. Accessible portion of AOC surveyed and intrusively investigated. The 1999 survey found only metal debris, much of which was domestic in origin (auto parts, nuts and bolts). No MEC items found. The 2008 instrument-aided inspection and site reconnaissance found only an artillery lifting lug and an expended M48 series fuze. No evidence of impact or detonations. Accessible portion of AOC surveyed and intrusively investigated. No MEC found. Surface water and sediment at SA93-02 not impacted by releases of MC.
Current ESHA Score:	A
MC Risk:	No unacceptable risk posed by human or ecological exposure to MC.
Uncertainties:	Uninvestigated ravine between SA93-01 and SA93-03 may contain MEC; steep slopes prevent access for further investigation.
Conclusions:	Characterization is complete, accessible portion of AOC surveyed and intrusively investigated, no MEC found
Recommendations:	Adak no further action with baseline institutional controls

Table 10-23
Summary of RI Findings and Conclusions—SA93-03

AOC Type:	Target/Impact Area
Investigation History:	**1999:** Geophysical survey of approximately 0.1 mile of transect (ribbon walk); intrusive investigation of nine targets. **2008:** 100 percent geophysical survey and intrusive investigation at one grid (Grid 14) occupying entire accessible portion of AOC. UXO found on western, eastern and southern sides of grid; triggering need for step-out transects to complete delineation. Step-out transects X1 through X6 completed on eastern and southern sides of grids. Step-out transects on west side not surveyed due to steep terrain and similarity in finds in nearby SA93-01. Soil sampling for MC at previously identified possible breached munitions location.
Investigation Results:	100 percent investigated and cleared in 2008. However the use of step-out transects to determine extent of MEC is not the same procedures used previously in OU B-2 (expansion grids). Materials found consist of 2.36-inch rockets, as well as MD associated with impact. Most UXO items were encountered within 1 foot of the surface. No UXO found in step-out transects. Extent of the target/impact area appears to extend westward across the ravine and into SA93-01. No MC was detected in the soil sample and no additional breached items were identified during the 2008 field investigation.
Applicability of Work to Level 2 Methodology:	Level 2 Methodology requirements for target/impact area fulfilled.
Nature and Extent Conclusions:	Site use consistent with the AOC type. Materials found consist of 2.36-inch rockets, as well as MD associated with impact. Most UXO items were encountered within 1 foot of the surface. Abundance and type of MEC in area west of Grid 14 assumed to be similar to that found in Grid 14. No UXO found in step-out transects. Extent of the target/impact area appears to extend westward across the ravine and into SA93-01. Soil not contaminated with MC.
Current ESHA Score:	A – However due to uncertainty about conditions along boundaries of AOC because transects rather than expansion grids used to determine extent of MEC contamination, the AOC is assigned to the FS group
MC Risk:	No unacceptable risk posed by human or ecological exposure to MC.
Uncertainties:	Degree to which MEC may be present in steep ravine adjacent to Grid 13 has not been determined. Steep slopes prevent access for further investigation. Also, uncertainty about extent of MEC contamination to the south and east due to use of transects, rather than expansion grids.
Conclusions:	Uncertainty about MEC along AOC boundaries may pose potential hazard to future users.
Recommendations:	Further evaluation to address MEC contamination (forward to FS). No further evaluation required to address MC contamination.

Table 10-24
Summary of RI Findings and Conclusions—SA93-04

AOC Type:	Storage Area
Investigation History:	**1999:** Geophysical survey of approximately 33 m (100 feet) of transect (ribbon walk); intrusive investigation of one target (100% of those identified). **2008:** Instrument-aided inspection and site reconnaissance of the accessible portions of the AOC to identify potential evidence of burial or disposal. No evidence of breached items that might be sources of MC found; no soil samples collected.
Investigation Results:	1999 survey found trash pile containing metal banding, metal crates, and a lid from an ordnance crate that originally contained 155-mm projectiles. 2008 reconnaissance found no MEC items or evidence of impact or detonations.
Applicability of Work to Level 2 Methodology:	AOC investigated as possible storage area based on 1999 finds. All Level 2 Methodology requirements fulfilled.
Nature and Extent Conclusions:	Site use does not appear to be consistent with AOC type. Inspection of the area found no evidence of site use consistent with either the initial AOC type (target/impact area) or the adjusted AOC type (potential storage area). Accessible portion of AOC surveyed and intrusively investigated. 1999 survey found trash pile containing metal banding, metal crates and a lid from an ordnance crate that originally contained 155-mm projectiles. 2008 reconnaissance found no MEC items or evidence of impact or detonations.
Current ESHA Score:	A
MC Risk:	Not applicable.
Uncertainties:	None.
Conclusions:	Characterization is complete, accessible portion of AOC surveyed and intrusively investigated, no MEC found.
Recommendations:	Adak no further action with baseline institutional controls

10.2 Summary of Recommendations

The information about AOC type, investigation history and results, applicability to Level 2 Methodology status, nature and extent of contamination, current ESHA score, MC risk, data gaps, and chemical risk assessment findings summarized in Tables 10-1 through 10-24 was used to develop recommendations about the status of and path forward for each AOC at OU B-2.

10.2.1 Adak No Further Action – Baseline Institutional Control Sites

The following AOCs have been sufficiently investigated or remediated to conclude that conditions at the sites do not pose unacceptable risks to possible human or ecological receptors, but that baseline institutional controls for OU B-2 may be appropriate:

- ALDA-02[1]
- BC-03
- JM-01
- LJ-02A
- MAG-01
- MM-10D

[1] The AOC may be reassigned to the FS category following 2012 field reconnaissance

- RG-01
- RR-02
- RR-03
- RR-04
- SA-01
- SA93-02
- SA93-04

Baseline institutional controls will be evaluated during the FS.

10.2.2 Remedial Action Sites

Data gathered during the 2008 RI and previous investigations are sufficient to conclude that conditions at the following AOCs might pose unacceptable hazards to future users of the sites and that possible remedial actions to address the risks should be addressed in an FS:

- ALDA-01
- ALSW-01
- C1-01
- HG-01
- MI-01
- MI-02
- MI-03
- OB/OD-01
- RR-01
- SA93-01
- SA93-03

SECTION 11
References

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